Electrical World

The consolidation of Electrical World and Engineer and American Electrician

Published by McGraw Publishing Company, Inc.

Vol. 62 NEW YORK, SATURDAY, JULY 12, 1913 No. 2

Receivers for Kuhn Utilities

The fate that has befallen the house of J. S. & W. S. Kuhn, of Pittsburgh, should not pass unheeded. One brother headed the First-Second National Bank, the other dominated the American Water Works & Guarantee Company, and both as a firm advertised widely and sold the securities of forty utilities. To this close community of interests is due whatever success has heretofore attended the firm's transactions, because, notwithstanding the fact that interests as unrelated and as diverse from one another as irrigation is from coal mining were held by the American Water Works & Guarantee Company, the latter has been successful as a holding company, earning about $1,750,000 last year. That success, however, has been predicated upon its ability to command large resources, and this it has been able to do because of the banking connections of the Kuhns. Robbed of this affiliation it tottered into receivership, and if it is not overcapitalized, a suspicion which is warranted by the wide diversity of its holdings, it must either unload or fall. The indications are that the fiscal agents of the American Water Works & Guarantee Company have discounted the future in their promotion schemes. Many of the underlying properties are good; but the finest property cannot forever pull along with it heavy burdens placed on it by financiers greedy of gain. In its investigation of the First-Second National Bank the government has intimated that it found something else besides slow assets and conditions deserving the attention of the Department of Justice, but whether these are as grave as would appear at first blush time only can tell. Collateral prized highly by the bank officials did not appear to be worth much to the government investigators or to other Pittsburgh bankers. This would point to pyramiding—an evil to which holding companies are peculiarly susceptible—and in times of financial stress the crumbling of one stone is sufficient to cause the whole structure to tumble.

$25,000,000 of Exports

We shall soon have the figures for June as to the exports of electrical apparatus, and these will undoubtedly show that for the first time in our history the amount for one year will reach and overrun $25,000,000. The returns for May are just to hand and have a very agreeable and satisfactory significance in that respect, as the total exports for eleven months had already reached $24,458,084. At this rate, the rounded year should give more nearly $27,000,000. As for May itself, the gain over 1912 is quite impressive, exhibiting a jump from $2,068,346 to $2,588,887. We have not gone through the entire returns, but a cursory glance at them is enough to indicate that very few branches of American industry whose product finds a foreign market can evidence any such capacity for expansion as that. In a good many other lines there is a distinct falling off or a condition of stagnancy. Even these quoted electrical figures are susceptible of a better interpretation, for many additional items ought to be included, as, for example, electric locomotives, which for some mysterious reason are grouped under "engines." It must not be forgotten that an overwhelming proportion of our copper, going abroad or staying at home, is of electrolytic refining, and that in other lines of metallurgy and chemistry the electrical percentage is gaining all the time. The department of American manufacture that has not felt the inspiring touch of electricity is a rare one, so that every year the summation of electrical output in goods for domestic use or for export becomes more and more difficult. The government authorities appear already to have "thrown up their hands" when it comes to giving complete and analyzed data as to the exports. We wish sometimes there were a body or society that could take up the fostering of this electrical export trade. It is obviously not the province of the American Institute of Electrical Engineers, the National Electric Light Association, or other national organiations of standing and repute, but it certainly ought to be somebody's job. The new Society for Electrical Development has chosen the home field for cultivation, and so far as we know makes no effort to reach outside except in Canada; but it is increasingly evident, especially when such figures of growth confront us, that a big foreign market awaits cultivation and development. Why cannot the Jovian Order take up the battle cry of a larger foreign trade? It would help the order and help the manufacturer and his employees. A standing committee of the organization could soon make its energies and efforts felt in the systematic pushing of everything American electrical all the time for everybody abroad.

A Neglected Opportunity

The scriptural injunction "Let your light so shine before men that they may see your good works" should be heeded by every central station without an electric sign upon the roof of its generating plant and substation buildings, for it is doubtful if a better means of advertising one's service from the housetops can be found. Certainly this form of publicity is greatly neglected, considering its low cost, both for installation and for operation. By using simple pipe framing for the support of letters formed by low candle-power tungsten lamps and supplying energy at nominal cost, a forceful appeal can be made to the public, particularly when the plant is located in

close range of any avenue of heavy travel. It takes only a few words to call the passer-by's attention to the advantages of electric service and give him the telephone number of the commercial department, and the company which fails to do this misses a brilliant opportunity in more senses than one.

London's Electrical Energy Supply

A recent elaborate paper in the London *Electrician* gives an account of the effective but inordinately intricate system of supply which meets the electrical needs of the world's greatest metropolis. The electricity supply in the metropolitan district is in the hands of thirty-one separate undertakings, part of them, including the largest individual outputs, being private corporations and the rest municipal undertakings by the various borough councils. It is euphemism to call the supply heterogeneous; some more inclusive and forceful word is necessary to describe the situation. One can find single-phase at 50 and 85 cycles, three-phase at 50 and 25 cycles, and both alternating-current and direct-current three-wire systems at all voltages utilized in such wise. Each borough has worked independently for the most part, and consequently one finds likewise steam plants of every conceivable kind, from simple reciprocating engines to the latest type of turbo-alternators, through about every sort of high-pressure, low-pressure and mixed-pressure turbine which has yet turned up on the British market.

A very interesting thing to note, however, is that four of Ferranti's original 10,000-volt alternators are still in operation after nearly a quarter of a century in the Deptford station of the London Electrical Supply Corporation, sufficient evidence both that Ferranti was ahead of his time and that he knew how to build extra good alternators in the days when such machines were none too common. The two largest electricity works in the system have between 40,000 kw and 50,000 kw in connection, and from that the list runs down to as low as 700 kw. No American city in the whole history of electrical development has displayed so variegated a system of supply, for the enterprises on this side of the water to a large extent have been private ones and have been consolidated before the state of things even remotely approximated that in London.

A curious fact which deserves investigation is that, somehow or other, the London plants manage to furnish, on the whole, astonishingly cheap energy both for motor service and lighting, and the charges run low whatever system of rates is employed. In most of the plants use is made of some form of demand system of charging, almost always moderated, however, by flat rates and sliding scales of various kinds. In fact, the systems of charging are as far from standardization as are the stations themselves. Some of the larger stations are built and operated on a strictly modern line and are able to turn out energy very cheaply. One, for example, reports a coal cost as low as 0.4 cent on less than 15,000,000 kw-hr. per year. This station has motor-service rates based on 2 cents per kw-hr. and sliding down to 1.2 cents. Many of the stations have made vigorous efforts to obtain heating and cooking business, for which special low rates are usually offered. Such business has been developed by enterprising publicity methods and has risen to the point in at least one station where the output for these purposes is about 40 per cent of the lighting output and practically double the motor output. Judging by results, the London stations present a very much more striking appearance separately than if regarded as what they are not, a consistent whole. Unquestionably a unification of the supply system would result in very considerable savings in some regions of the metropolis. The actual state of things, however, seems to indicate that, given a dense population to be served and an area which compared with the American practice is small, a well-equipped and well-administered station can turn out and supply energy at an astonishingly low figure, a figure quite comparable with that reached in many a larger and more pretentious station handicapped by less density of load.

Telephone Transmission Phenomena

Appearing in the *Digest* this week is the concluding abstract of a very comprehensive paper on telephone transmission by Mr. A. J. Aldridge, read before the Institution of Electrical Engineers and reprinted in large part in the London *Electrician*. One of the interesting features to telephone engineers on this side of the water is the author's calculating scale for use in transmission calculations, which apparently shortens materially the somewhat involved computations required in transmission work. Among the author's significant conclusions, verified by oscillograph studies of voice current, is the equivalence of a single frequency of 800 cycles for use in transmission calculations. While this result is not new, the method of analysis and the experimental observations add weight to the similar conclusion reached by other investigators. The author brings out a number of facts in regard to reflection losses which, although known in this country, have not been extensively discussed. The normally accepted equivalents of uniform lines, loaded or non-loaded, do not, when added together, give the true equivalent of a through line of composite character. The reason for this is the loss or gain which occurs at junctions of dissimilar sections, termed the reflection equivalent. While the latter in many cases involves an actual loss, this is not always the case, as when a section of non-loaded terminal cable is connected to a long line of loaded open wire. The reflection losses become most noticeable in the case of short lines, where the reflection equivalent bears the maximum ratio to the total equivalent of the line. However, the over-all transmission is the same in either direction over a line of compound or composite character, although the distribution of losses in the two cases will be dissimilar. In the case of short lengths of loaded cable, taken alone, the reflection losses become so predominant that as the line is further shortened the transmission, instead of becoming better, really becomes worse.

In all transmission calculations the electrical constants of the line play a fundamental part. It is well established that the true constants, measured with direct currents or at very low frequencies, change very materially as the frequency increases and the apparent constants at high fre-

quency depart in great degree from those first mentioned. This fact was brought out both in the discussion of Mr. Aldridge's paper and in Dr. A. E. Kennelly's paper on the test of an artificial aerial telephone line, read at the Cooperstown convention of the A. I. E. E. What is found to be true of the real line is also found in a measure to be true of artificial lines. This aspect of the question, now that the hyperbolic theory propounded by Dr. Kennelly has been well established and verified, becomes of leading importance, and it is to be hoped that papers dealing with the variation of line constants, so called, with the frequency will be forthcoming at a near date. In this direction, perhaps, there is a field for achieving some further improvement in transmission efficiency.

Phase Compensation

Although the disadvantages of low-power-factor loads on transmission systems have long been recognized, only within the past few years have steps been taken to improve the power-factor to a marked extent or to compensate for its effect upon transmission systems. Among the many methods developed for this purpose the one most commonly employed is that involving the use of synchronous apparatus as "condensers." This method is discussed at considerable length in this issue in connection with several papers on the subject presented at the recent convention of the American Institute of Electrical Engineers. A method involving the use of the induction type of apparatus, which may seem to differ considerably from the above but is really essentially the same so far as operating results are concerned, is described in an article by Mr. Val. A. Fynn, the second instalment of which appears in this issue.

As ordinarily constructed, the induction type of apparatus depends for its exciting magnetomotive force upon lagging wattless current taken from the supply system through the primary coils of the machine. However, this is not an essential feature of the apparatus; magnetomotive force can be applied locally to the secondary coils, thereby varying the amount of wattless current in the primary coils to any desired extent. By means of a commutator on the revolving secondary magnetomotive force may be applied in any chosen space-phase position with reference to the stationary primary coils. It is evident at once that by placing the stationary secondary circuit in direct space-phase with the primary circuit, any magnetomotive force introduced into the secondary will directly affect the magnetomotive force required in the primary circuit, depending only upon the relative time-phase positions of the primary and secondary magnetomotive forces.

It is, perhaps, not so well known that when the stationary secondary circuit is placed in space-quadrature to the primary circuit, magnetomotive force introduced in the secondary circuit affects the primary current in the same degree as though the primary and secondary circuits were coincident in space-phase. In this case, however, between the two currents there is a displacement in relative time-phase equivalent to the displacement in space-phase of the primary and secondary circuits. Mr. Fynn has devised an excellent method for applying phase compensation to the induction type of machine. Current in the proper time-phase position for producing exciting magnetomotive force in the secondary is obtained by transformation either directly from the main supply system or indirectly therefrom by means of a secondary coil located on the stationary core of the machine in position to be affected by the machine's transformer flux. Experience has confirmed the theory that magnetomotive force applied to the secondary in space-quadrature to the primary coil can be so adjusted as to supply all of the exciting magnetomotive force required by the machine, thereby reducing to zero the wattless-volt amperes taken from the supply system and increasing the power-factor to unity.

The Rating of Incandescent Lamps

Some important data regarding tungsten lamps have recently appeared in a report of the British National Physical Laboratory. The chief matter of interest is the report on the life of various commercial lamps purchased on the open market. The makers of the various lamps are unfortunately not stated. The result of the test was rather disappointing. The lamps, to be sure, were of the smaller sizes, part of them of the 220-volt type, but the breakage prior to 1000 hours was very serious, more than 70 per cent of the 220-volt lamps succumbing before this period and more than 30 per cent of the 105-volt lamps. On the other hand, those lamps which survived for 1000 hours generally maintained the candle-power within the 20 per cent drop.

Another important feature of the test was a trial of the lamps at a specific consumption of 1 watt per candle as against the standard 1.2 watts per candle. Under this condition the drop in candle-power was enormously increased in all the lamps, and the result showed plainly that for the lamps tested a specific consumption of 1 watt per candle is considerably smaller than is safe. In a general way, the report states that in the neighborhood of 1.2 watts per candle a variation of 0.20 watt per candle will lengthen or shorten the life by about 25 per cent. Unfortunately the details of the lamps are not sufficiently well given for obvious reasons to enable one to place them as regards manufacture and character of filaments. It is sufficiently evident, however, that the British lamps at least do not show from these tests anything like such good results as would be obtained from American lamps of standard manufacture. Whether this is because the manufacturers on this side of the water are decidedly ahead of the game in skill or whether Great Britain has been made the dumping ground for lamps which would not pass muster elsewhere we cannot say with certainty, but we are inclined to believe that the chief difference is the former one. There is no doubt that any impartial set of tests of American lamps would show much better results than those here indicated. Some of the performances recorded from American lamps of the larger sizes are truly remarkable and show that great strides have been made in tungsten-lamp manufacture within the last year or two. It is also highly probable that present types of British lamps would show considerable improvement over those covered by the report here noted.

The News of the Week

Activities and Events in the Electrical Field—Reports of Meetings—Commission Findings, Etc.

Collapse of Kuhn Projects

On July 7 the various projects controlled by the Kuhn interests of Pittsburgh, Pa., collapsed. On that day the First-Second National Bank of Pittsburgh was closed by order of the Controller of Currency, the First National Bank of McKeesport suspended and the American Water Works & Guarantee Company and the banking house of J. S. & W. S. Kuhn were forced into the hands of receivers. Acording to the Assistant Secretary of the Treasury the examination made by the Treasury Department showed favoritism in the bank loans and in general an extremely bad condition in that the First-Second National Bank was apparently financing the private projects of those in the institution. The failure of the First-Second National also precipitated a run on the Pittsburgh Bank for Savings, of which Messrs. J. S. and W. S. Kuhn were president and vice-president respectively; but the run abated considerably on July 8 when both the Kuhns resigned.

J. S. & W. S. Kuhn, Inc., are incorporated in Delaware with a capital stock of $500,000. The firm has interested itself largely in Western irrigation projects, controls the West Penn Traction & Water Power Company, a group of bituminous mines in Pennsylvania and is at present engaged in building a hydroelectric development on the Cheat River in West Virginia. Mr. W. S. Kuhn is president of the First-Second National Bank of Pittsburgh, vice-president of the American Water Works & Guarantee Company, vice-president of J. S. & W. S. Kuhn, Inc., president of the Sacramento Valley Irrigation Company, president of the Twin Falls North Side Land & Water Company, president of the Kittanning & Leechburg Railway, vice-president of the Pittsburgh Bank for Savings, vice-president of the First National Bank of Allegheny and a director of the Colonial Trust Company, Commercial Trust Company and Commercial National Bank of Pittsburgh. Mr. J. S. Kuhn, besides being president of the First National Bank of Allegheny, First National Bank of McKeesport and the Pittsburgh Bank for Savings, is president of the American Water Works & Guarantee Company, a director of the Colonial Trust Company and Freehold Bank of Pittsburgh, director in Kuhn, Fisher & Company, Inc., of Boston, director of the Security Investment Company and Twin Falls North Side Land & Water Company, director in the Westinghouse Electric & Manufacturing Company, vice-president and director of the United Coal Company, West Penn Traction Company and the West Penn Traction & Water Power Company.

The American Water Works & Guarantee Company, which originally owned and operated six water works and two glass plants, now owns, controls and operates about forty constituent companies in seventeen states. It issued no bonds but has $10,000,000 preferred and $10,000,000 common stock. Its powers as a constructing and a holding company cover water works, gas, electric light, heat, sewerage and drainage plants, irrigation works, canals, steam railroads, street railways and industrials wherever located. Its stock holdings, however, are chiefly in water works, its electrical properties comprising the West Penn Traction & Water Power Company, the principal subsidiary of which is the West Penn Traction Company; Great Shoshone & Twin Falls Water Power Company of Idaho, Southern Idaho Water Power Company, Mount Vernon (Ind.) Electric Light & Power Company, Wellsville (N. Y.) Electric Light, Heat & Power Company and the Hydroelectric Company of West Virgina. Since 1889 the stock of the American Water Works & Guarantee Company has paid an annual dividend of 6 per cent, and in June, 1912, a stock dividend of 150 per cent was declared from the surplus. The securities of the subsidiary companies aggregate $110,718,800, of which $73,128,800 is in stock, and of this the American Water Works & Guarantee Company holds $46,481,050 (par value), the book value being given as of May 1, 1913, as $10,433,362. The funded debt of the subsidiary companies is $37,580,000.

The government has made no statement other than that the capital of the First-Second National Bank had been impaired. It is significant that the Pittsburgh Clearing House committee after a careful investigation refused aid. Diversified opinions have been expressed by persons supposedly conversant with the situation as to the cause of the failure and its effect on public utility securities. As financiers the Kuhns are not highly regarded by New York banking houses, and it has been suggested that the Pittsburgh firm has been pyramiding financially and has been too optimistic as to the future. Questioned as to the class of public utility securities which might have caused embarrassment, a Pittsburgh banker has vouchsafed the information that the Kuhn interests have quite a lot of money tied up in the California-Idaho Company, which controls extensive irrigation projects in the Sacramento Valley, and also in the Hydroelectric Company of West Virginia, which is erecting a hydroelectric plant on the Cheat River near the Pennsylvania-West Virginia state line. Many millions have been sunk in the irrigation project, and only a few hundred thousand dollars of the securities have been disposed of. In the case of the Cheat River developments, which will entail an expenditure of approximately $15,000,000, about $4,000,000 has already been expended and the work is only partially completed. Much opposition has been encountered in the latter development from individuals claiming rights on the river and also from the State governments. Whether or not the American Water Works & Guarantee Company will be split up into its constituent companies, each of which will be operated separately, is problematical. None of the other banks in Pittsburgh is affected, nor has the trouble extended to any other investment center. However, the belief is prevalent that the failure will have some effect on the sale of public utility securities, which under present money conditions are hard to sell at best.

I. E. S. Officers

As a result of the letter-ballot election recently conducted by the Illuminating Engineering Society, the following officers were chosen for various terms beginning Oct. 1, 1913: President, Mr. Charles O. Bond; vice-presidents, Messrs. George H. Stickney and Ward Harrison; general secretary, Mr. Joseph D. Israel; treasurer, M. L. B. Marks; directors, Messrs. F. J. Rutledge, C. A. Littlefield and F. A. Vaughn. Messrs. Israel and Marks were re-elected to their respective offices.

Electrical Development Society Activity

At a full meeting of the board of directors of the Society for Electrical Development, Inc., held at the headquarters in the Engineering Societies Building, New York, on July 9, arrangements were made for carrying forward actively the plans of the society so that the work in aid of the electrical industry may be well under way by the beginning of the fall lighting season. The organization committee advanced additional funds for this purpose, and the membership campaign will be pushed with vigor so that pledges totaling $200,000, the minimum required, may be obtained at the earliest possible moment. All persons who are interested in the aims of the society are urged to become members at once in order that their pledges may aid in bringing the total without delay to the necessary minimum. Only a small part of the amount pledged will be needed for the beginning of the active work, but it has been agreed that the subscriptions must reach $200,000 before any of it can be used.

Much information concerning the aims of the society is given in the prospectus now being distributed to all persons interested. The by-laws of the society are so drawn as to give equal representation to all branches of the electrical industry. A general invitation is extended to all individuals, partnerships and companies composing the electrical industry to become members. Although the dues are based on the gross amount of the sales made annually by the members, yet it is unnecessary for a member to make public the information concerning the exact amount of his sales. A member may subscribe in accordance with a classification in groups, of which there are seventeen, each group representing sales of from one and one-quarter to two and one-half times the amount of the next lower group.

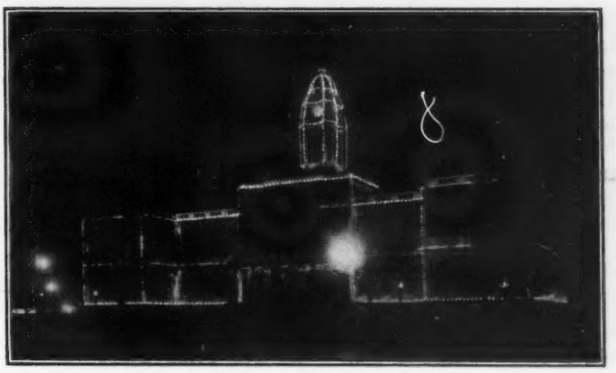
Electrical Illuminations on New York's Sane Fourth

Elaborate electrical illuminations this year took the place of the usual municipal displays of fireworks with which New York City has been celebrating recent sane Fourths of July. Public buildings and monuments were outlined

SOLDIERS AND SAILORS' MONUMENT

with thousands of electric lamps, and the trees of numerous city parks were studded with Japanese lanterns and varicolored lighting units. In all, some 17,000 8-cp lamps were used, the energy for operating the displays being furnished gratis by the New York Edison Company, so that the only cost to the city was the installation of the lamps, which was done by private electrical contractors. The illumination was continued July 4, 5 and 6, being operated each night from 7:30 p. m. to 12 midnight.

The outlining of the City Hall, pictured herewith, required 3000 lamps and was furnished complete by the Edison company. Washington Arch, at the foot of Fifth Avenue, was outlined with 2000 lamps. One of the most effective displays was that attained with 1000 lamps on the



ILLUMINATION OF CITY HALL

Soldiers and Sailors' Monument, Riverside Drive, also shown in an accompanying illustration. In the Mall, Central Park, 3000 lamps were inclosed in Japanese lanterns, gracing the trees, walks, fountains and water vistas, while colored lanterns projected their variegated illumination over the scene. Nearly 2000 lamps were used to outline Bronx Borough Hall, this decorative installation having been similarly donated by the company. In a dozen outlying parks strings of electric lamps were festooned through the trees, and moving-picture exhibitions of patriotic films were presented during the evening of the Fourth.

Program for Ohio Convention at Cedar Point Next Week

The nineteenth annual convention of the Ohio Electric Light Association will be held at Cedar Point, Ohio, July 15 to 18. Among the papers to be presented at the convention, which opens with an address by President J. C. Martin, Wilmington, Tuesday afternoon, will be the following: "Cooking by Unity-Load-Factor Electric Ranges," by Mr. M. L. Turner, Cleveland; "Retention of Business of Dissatisfied Customers," by Mr. T. F. Kelly, Dayton; "New Business," by Mr. J. E. North, Springfield; "Developing and Diversifying the Present Load," by Mr. H. E. Armstrong, East Liverpool; "The Human Equation," by Mr. S. G. McMeen, Columbus; "Meters," by Mr. A. H. Bryant, Cleveland; "Long-Distance Transmission," by Mr. M. H. Wagner, Dayton; "Franchises," by Mr. J. V. Oxtoby, Detroit, and "Illumination as a Commercial Product," by Mr. A. M. Seeger, Toledo. The usual elaborate entertainment program has been provided, including the annual banquet, reception, dances, musicales, boat rides, ball games, Jovian rejuvenation, etc. Mr. D. L. Gaskill, Greenville, Ohio, is secretary of the Ohio Electric Light Association.

Convention of National Electrical Contractors' Association

The thirteenth annual convention of the National Electrical Contractors' Association will be held at Chattanooga, Tenn., July 16, 17, 18 and 19. The headquarters and registration bureau will be at the Hotel Patten, at which place the open and business sessions will also be held. A directors' meeting is scheduled for the morning of July 15, and

at the open session to be held on the morning of July 16 speakers on subjects of general interest to the trade will be heard. The afternoon will be devoted to a business session for members only, and in the evening there will be a lecture on illumination followed by a reception and dance. A rejuvenation of the Sons of Jove is also scheduled for the evening of July 16. The sessions on July 17 and 18 are to be held behind closed doors and on the evening of July 18 the annual dinner for guests and members will be held at the Hotel Patten. The entertainment features comprise an automobile trip to Chickamauga Park and Fort Oglethorpe on July 17; an afternoon tea to be given by the Chattanooga Electric Club at the Hotel Patten on the afternoon of July 18; a trip to Signal Mountain with luncheon at the Signal Mountain Inn on July 19, and a trip by special train to the Tennessee lock and dam in the afternoon.

Standardization of Electric Cooking Apparatus

Reference has been made in this journal to the activities of the English society known as "The Point Fives," which is composed of managers of organizations supplying electricity. The title of the society is derived from the effort to further a secondary rate for electricity, under certain conditions, of a half-penny, or 1 cent in American currency. At a recent meeting there was a rather interesting debate on the standardization of electric cooking utensils, which resulted in the following recommendations:

Domestic and other ranges (consisting of oven, grill and hot-plates) should have each a sub-circuit separately fused and protected by a switch. The oven should have two or more circuits.

Switches and fuses should be placed in such a position that they cannot become unduly heated or damaged by liquids being spilled over them, and so that they may be easily accessible.

Provision should be made for the efficient grounding of all apparatus.

Ranges should be fitted with at least one indicating device, separately fused, which will show clearly whether any circuit is turned on.

Manufacturers and designers should endeavor to develop a hot-plate which will work satisfactorily at red heat.

Effect of Foreign Co-invention on Validity of Domestic Patent

An interesting patent cause between the Westinghouse Machine Company and Coloman De Kando, complainants-appellants, and the General Electric Company and A. H. Armstrong, defendants-appellees, was decided last month by the United States Circuit Court of Appeals for the second circuit, Judge Lacombe rendering the opinion, which is given here in substance.

The real point at issue was the extent to which the validity of an American inventor's patent is affected by simultaneous or even prior, but independent, invention in a foreign country. The case grew out of an interference in the Patent Office, entitled De Kando versus Armstrong, which was decided adversely to the former and his assignee, the Westinghouse Machine Company. The interference was between an application of De Kando's filed July 3, 1906, and a patent issued to Armstrong, No. 811,758, on Feb. 6, 1906, on an application filed June 28, 1905. The invention in question was a system of separate or individual resistors for the secondaries of three-phase induction motors on electric locomotives, designed to assist in equalizing the load among the motors or between two or more locomotive units coupled together. The merit of the system consisted in overcoming the difficulty which would arise if a common resistor were used and the respective motor speeds were not identical, under which conditions the motors would be unequally loaded.

The suit was brought under Section 4915 of the United States Revised Statutes, which provides that whenever a patent on application is refused either by the commissioner or by the Court of Appeals of the District of Columbia upon appeal the applicant may have remedy by a bill in equity and the court may adjudge the matter. The bill in this cause was dismissed by Judge Ray in the United States District Court for the northern district of New York, and then appeal was taken. Judge Lacombe reviewed certain facts set forth in the evidence given below, as follows: De Kando, the foreign co-inventor, made his invention in 1904 or prior thereto and applied it on the Valtellina railway in Italy in the spring of 1904. In March of the latter year a well-known American engineer visited De Kando, saw the invention in use and in May returned to America with a full description of it which he subsequently imparted to others, and on June 19, 1905, presented before the American Institute of Electrical Engineers. The purpose of this visit was to obtain knowledge of De Kando's invention and introduce it in this country. Armstrong's date of conception was prior to 1901 or 1902, but he did not file application until June, 1905.

Judge Lacombe pointed out that the crucial question was whether Armstrong, in the admitted circumstances, was entitled to the grant of his patent. This question involves two sections of the patent law, Sections 4886 and 4923 of the United States Revised Statutes, next given:

"Section 4886. Any person who has invented or discovered any new and useful art, machine, manufacture or composition of matter, or new and useful improvements thereof, not known or used by others in this country before his invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country before his invention or discovery thereof or more than two years prior to his application, and not in public use or on sale in this country for more than two years prior to his application, unless the same is proved to have been abandoned, may, upon payment of the fees required by law, obtain a patent therefor."

"Section 4923. Whenever it appears that a patentee, at the time of making his application for a patent, believed himself to be the original and first inventor or discoverer of the thing patented, the same shall not be held to be void on account of the invention or discovery of any part thereof having been known or used in a foreign country before his invention or discovery thereof, if it had not been patented or described in a printed publication."

The complainants contended that when the knowledge of De Kando's invention was brought to this country in May, 1904, it became "known" in the legal sense before Armstrong's application was filed. The Court of Appeals of the District of Columbia held in substance that for the purpose of defeating a patent application reduction to practice in a foreign country is a nullity unless the invention is patented or described in a printed publication, and the present opinion leans to the same view. If Section 4886 stood alone, the case might be different, since the De Kando invention was known in this country prior to the Armstrong date. But the patent law is contained in many sections and they must be construed together. Section 4923 deals specifically with the effect of knowledge and use in a foreign country and it makes no distinction whether such is made or such knowledge is acquired by persons who, after using the thing or acquiring the knowledge, remain abroad or come here. The patent taken out here for the same thing shall not be void on account of such use or knowledge unless the invention had been patented or described in a printed publication. Thus Section 4923 qualifies Section 4886, and the Circuit Court affirmed the decree of the lower court and sustained the validity of the Armstrong patent.

Kelvin Memorial at Belfast

A memorial statue to the late Lord Kelvin was unveiled in the Botanic Gardens Park of Belfast on June 19. The money for the statue was subscribed by the people of the city and the statue itself was executed by Mr. Albert Bruce-Joy. The figure is 10 ft. high and stands on a 13-ft. granite pedestal. It represents the subject standing erect with the left hand extended and holding in it a design of one of his discoveries—an adaptation of the gyroscope. In the right hand is a pencil pointing to the drawing. The

STATUE OF LORD KELVIN

sculptor has depicted the illustrious scientist in the prime of life and intellectual power and has made a special effort to bring out the personality of the man. By the side of the figure, which is draped in a doctor's gown, stands a representation of the well-known Kelvin compass. At the unveiling ceremony Sir Joseph Larmor delivered a tribute suited to the occasion, dealing with Lord Kelvin's home training, his life at Cambridge and Paris, his achievements and fame in the scientific world, the legacy in physical science that he has left, his personal qualities and distinction as a patriot as well as a man of science.

The Glasgow University statue of Lord Kelvin is to be unveiled in October by Mr. Birrill as lord rector, and the address will be delivered by Mr. Balfour, the Gilford lecturer. The Westminster memorial, which takes the form of a stained-glass window, will be unveiled some time this month. Members of British and American engineering societies to the number of 1296 subscribed over $8,000 for the latter memorial.

Organization of Louisville Merger Company

Final details looking to the organization of the Louisville Gas & Electric Company, the merger of the local utilities of Louisville, Ky., were completed July 2, with the exception of the taking over of the Kentucky Electric Company, delayed pending the formal dismissal of the city's suit to restrain such action and the payment for the stock of the shareholders pooled for the purpose.

The Louisville Gas Company, the Louisville Lighting Company and the Kentucky Heating Company and its associate corporations were joined under the new title and have ceased activities as operating companies, although they will, of course, continue to maintain a corporate existence. The Louisville Gas & Electric Company of Kentucky, which replaces them, is capitalized at $11,000,000 and has authorized a bond issue of $15,000,000, $7,500,000 of which has been offered. The Louisville Gas & Electric Company of Delaware, its holding company, has $18,000,000 capital stock.

The board of directors of the new company is composed of Messrs. H. M. Byllesby, J. J. O'Brien, Arthur S. Huey and Otto E. Osthoff, of the Chicago organization of Byllesby & Company; James B. Brown, John W. Barr, Jr., John H. Whallen, Donald McDonald, Charles H. Doherty, Daniel E. Doherty, H. D. Rodman and Robert M. Trimble, Judge Matt O'Doherty and General George H. Harries.

The executive committee is made up of Messrs. H. M. Byllesby, G. H. Harries and Donald McDonald, ex officio, and Charles J. Doherty, James B. Brown and J. J. O'Brien.

The officers are Messrs. H. M. Byllesby, chairman of the board; George H. Harries, president; Donald McDonald, vice-president and general manager; James B. Brown, vice-president; F. C. Gordon, vice-president; R. F. Graf, secretary; T. B. Wilson, treasurer and assistant secretary; Herbert List, assistant secretary and assistant treasurer; Thomas W. Kennedy, assistant treasurer. It is stated that Mr. Graf's appointment is only temporary and that Mr. Kennedy will be the permanent secretary.

In addition to these elected officers, announcement has been made of the appointment of Mr. Herbert L. Harries, son of General Harries, to the post of assistant general manager. Mr. G. Wilbur Hubley, formerly chief engineer of the Louisville Lighting Company, has been appointed electrical superintendent. Mr. H. W. Fuller, who for six months has been general manager of the Louisville Lighting Company, is to return to the general offices of H. M. Byllesby & Company at Chicago.

Electric-Service Rate Discussion in Chicago

At the meeting of the committee on gas, oil and electric light of the Chicago City Council on July 7 Mr. Ray Palmer, the city electrician, answered some of the objections made by Mr. William G. Beale, counsel for the Commonwealth Edison Company, to the report of Mr. Palmer on the rates of the Commonwealth Edison Company.

As to maximum rates, Mr. Palmer said that the classification of rates is a practical necessity. Maximum rates fixed on the basis of some small individual customers whose maximum demand is practically coincident with the maximum demand on the system would result in unreasonably high rates for the general public. If the rates must be fixed so as to result in a profit for the company in the case of every individual consumer, there would be practically no limit to the maximum rate.

In reference to the allowance to be made for the cost of paving over conduit, Mr. Palmer declared that full value is allowed, in his report, for paving in every instance where it was paid for by the company. As far as possible the valuation in the report has been made on the basis of original cost. In the Kings County lighting case the Appellate Division of the Supreme Court of the State of New York limits its decision on paving over conduit to the basis of reproduction value.

In relation to franchise value, Mr. Palmer contended that if a capital allowance is to be made for such value on the theory that the company is annually paying about $500,000 in taxes on this value, it follows that the company must pay the amount of such tax out of capital funds supplied by stockholders and not take the payment out of gross receipts and penalize consumers by a rate which includes this amount.

Referring to property acquired in advance of present requirements the city electrician said that in the case of generating-station and substation construction interest-carrying charges were added as a part of the construction cost to reimburse the company for the loss suffered in paying

interest on funds borrowed for construction purposes while a portion of the plant was in course of construction. Exclusions were made in the case of property which had no direct relation to the supplying of electricity or which was held for sale when a favorable opportunity arose.

Mr. Edward W. Bemis, public utility expert, explained to the committee the provisions of the new law creating a public utilities commission for the State of Illinois.

Lexington Franchise Referendum Declared Invalid

The Kentucky Traction & Terminal Company, of Lexington, Ky., has double troubles at present, being engaged in a contest regarding its franchise, as already noted in these columns, besides having a strike of construction men on its hands. The city commission of Lexington recently awarded to the Lexington Utilities Company, the local subsidiary of the Kentucky Traction & Terminal Company, a twenty-year franchise which was later canceled, as the result, it was announced, of a popular referendum vote on the question. The company now protests that 643 names on the petition which resulted in the election were withdrawn, being either not registered or otherwise invalid. It is now, therefore, possible that the referendum will be declared null and void, and in this case the franchise granted by the commissioners will become effective. The construction men's strike, which started in Lexington and has since spread to other points where the local company operates, is based on the demands of linemen for a nine-hour day at 30 cents an hour instead of a ten-hour day at 27½ cents an hour.

Submerged Weir for Niagara River

The International Waterways Commission has recommended to the United States and Canadian governments the building of a submerged weir in the Niagara River. The weir will extend from Hog Island, just above Welland River on the Canadian side, to a point opposite Gill Creek, on the New York shore. If carried out, the restriction to flow will raise the level of the upper waters of the Niagara through a height of 3 ft. for a distance of approximately 1.5 miles. The effect opposite Buffalo will be an increased level at low water of 1.08 ft. and at flood of 0.19 ft. The level of Lake Erie will be raised 0.31 ft. at low water, 0.39 ft. at mean level and 0.11 ft. at extreme flood level. Extending into the upper lakes, the mean level of Lake St. Clair would be influenced to an extent of 0.23 ft. increase and that of Lake Huron by 0.09 ft. The cost of the weir, including the levee necessary to protect adjoining shore properties, is estimated at $3,500,000. The proposed dam, it is claimed, will have no appreciable effect upon the waters below it, and Lake Ontario and the St. Lawrence River will not suffer from a perceptible decrease in flow from the Niagara. The commission pointed out that the weir would be of value in eliminating any injurious effect upon the level of Lake Erie due to the diversion of water at Niagara Falls for the generation of electricity.

Decree in Copper-Clad Steel Infringement Case

In December, 1910, the Duplex Metals Company, manufacturer of copper-covered steel wire made under the Monnot patents and sold under the trade name of "copper-clad steel," brought a suit in equity against the Standard Underground Cable Company, alleging infringement of one of the Monnot patents and also unfair competition in trade. The latter concern was marketing a copper-covered steel wire which has been known as "Colonial copper-clad" and manufactured by the Colonial Steel Company. The cause was duly referred to a master in chancery and testimony taken, the record becoming voluminous. The chief contentions in the infringement case arose over the question whether the product sold by the Standard company was one in which the copper covering was actually welded to the steel core or base, for if such a weld existed, it was argued that the "Colonial copper-clad" product clearly infringed the Monnot patent, No. 893,932, granted July 21, 1908, for improvements in copper-clad iron and steel and owned by the complainants.

On June 25 last the case came before the court on motion by the complainant to dismiss the bill in respect to the charge of infringement, the motion being supported by an affidavit by one of the officers of the Duplex Metals Company and offered in its behalf, the substance of which is herewith given.

Prior to October, 1908, the defendant handled and sold the complainant's copper-covered steel wire, but sometime thereafter commenced to sell copper-covered steel wire manufactured for it by the Colonial Steel Company. Such of the latter wire as the affiant could obtain prior to October, 1910, was tested for a weld by means of mechanical tests such as bending, torsion, etc., tending to strip the copper from the steel, and declared to be unwelded. But during October, 1910, the affiant stated that he obtained certain samples of the Colonial wire which apparently were welded, and thereupon arranged to bring suit. In the affidavit it was stated that the metallurgical expert for the defendant had testified that the process of manufacturing copper-covered steel wire employed by the Colonial company could not produce a true weld between the copper and the steel, and in effect that such a process could produce no more than a strong mechanical adhesion of the metals. The affiant also stated his concurrence with the views of the expert for the defense.

Based upon this distinction between a weld, technically defined as such, and mechanical adhesion, as applied to a union between copper and steel, the complainant filed a motion to dismiss the infringement charge, without prejudice. This motion was opposed by the defendant, which argued that the dismissal should be upon the merits of the case, thus disposing of the infringement question instead of leaving it open.

The following decree was thereupon handed down on June 25 by the United States District Court for the western district of Pennsylvania, at Pittsburgh.

"Complainant having admitted that defendant's product referred to in the proofs herein does not infringe the Monnot patent in suit, No. 893,932, it is ordered adjudged and decreed that the bill of complaint herein, in so far as it is based on alleged infringement of said patent, be, and the same hereby is, dismissed on the ground that defendant has not infringed said patent, and so dismissed with costs to be taxed."

There still remains that part of the bill of complaint relating to the charge of unfair competition in trade in using the name "copper-clad," which the complainant alleges is its solely. It is expected that this will reach a hearing early in the fall.

Methods of Large Engineering and Construction Company

At a recent meeting of the Boston Section of the American Institute of Electrical Engineers a paper was presented by Mr. Roy Manwaring Henderson, assistant construction manager of the Stone & Webster Engineering Corporation, Boston, Mass., on the organization and methods of that establishment.

Prior to giving a detailed description of the organization and its office and field methods, the speaker pointed out that the establishment and growth of such concerns have occurred as a result of the tendency toward centralization in

Electricity on the Farm

$175 for 2 hp, $225 for 3 hp, etc. On one line 12 miles long

most lines of business, the increased size and scope of engineering and industrial undertakings, the better facilities afforded for handling complex projects by a single interest, and the additional engineering services which no previous type of organization was in a position to render.

Among the advantages secured by such an organization in handling work are the following:

(1) Elimination of the fundamental weakness of divided responsibility for engineering and construction.

(2) Elimination of the conflicting financial interests of separate contractors by utilizing an organization whose interests are identical with those of the owner.

(3) Elimination of time losses by making the period for construction overlap instead of following the period for engineering.

(4) Elimination of a further loss of time during the construction period due to lack of team work when the work is executed by a number of separate contractors.

(5) Elimination of the duplication of organization in at least the executive and clerical branches of separate contractors.

(6) Elimination of exorbitant profits frequently paid for extras occasioned by errors of omission and commission in the specifications, plans or contracts; also the heavy penalty paid for changes found necessary as the work progresses.

(7) Elimination of the loss to the client by reason of the fact that he formerly paid to each contractor or subcontractor in the contract price, a sum which had been included by the contractor as a contingency allowance or measure of the risk assumed. A large portion of the contingencies against which the contractors were protecting themselves never materialized, and if the owner could have assumed these risks himself he would have saved money in the majority of cases.

(8) The elimination of at least part of a corps of nonproductive but necessary inspectors.

The time element is worth further analysis.

Formerly plans and specifications were prepared after a careful investigation of physical and other local conditions. Contractors were then invited to bid or bet on what would be encountered many feet below surface of the ground or in a river-bed, and on how many holes would be found in the specifications through which extras could be secured, and in due course the successful bidder would receive a contract which he would usually handle by means of a number of sub-contracts, doing the fewest possible parts of the work himself. To complete this procedure and arrive at the point of beginning actual construction frequently required months.

In the case of the modern engineering and construction company the field engineers are hardly well started on their preliminary investigation of physical conditions which will govern plans and estimates of cost before the construction forces start their preliminary work of demolishing old structures, building rail or wagon roads, clearing timber, establishing camps, planning the construction plant, ordering and assembling construction equipment, scouting for materials and locating sources of labor supply, so that by the time the engineers can get out the location, excavation or foundation plan the construction force is sufficiently organized and equipped to start actual construction immediately. Thus at the very beginning weeks and more often months are saved, and until well along in the job the engineers have their own troubles in keeping up with the construction forces, while they have the benefit of the opinions of the construction men at the time the plans are being prepared so that they can give every consideration to the local conditions which will affect construction and costs. Only the smallest possible amount of work is given to subcontractors so that by far the greatest proportion of the work is under the direct control of the organization handling the job. Modern business methods, systematic preparation, definite assignment of responsibilities and a flexible line-up of departmental relations all contribute to increased efficiency, which results in saving time all along the line. These accumulated savings of time result in the power plant or building being completed and on an earning basis much sooner than was formerly possible, to which must be added the advantage of a reduction in interest charges during construction. These two items more than offset any imaginary or real additional cost incurred by reason of foregoing the questionable advantage of competitive bids.

Canadian Electrical Association Papers

Last week's issue contained an account of the proceedings of the convention of the Canadian Electrical Association held in Toronto on June 25 to 27. Below are to be found abstracts of papers and discussions on the subjects of wiring rules, electricity on the farm, service, pole-type transformers and central-station advertising.

Wiring Rules

In a paper entitled "The Hydro-Electric Rules and Regulations and the National Electrical Code," Mr. H. F. Strickland, of the Hydro-Electric Power Commission of Ontario, pointed out the difference between the rules promulgated by the Hydro-Electric Power Commission and those of the National Electrical Code. The Hydro-Electric rules and regulations have not been drafted with the idea of covering every conceivable form of construction as has been attempted in the National Electrical Code, but have been drawn for the purpose of covering all such inside wiring as will be met with in every-day practice and which anyone is liable to be called upon to perform. While a large percentage of the rules are an adaptation of the National Electrical Code, it has been a very difficult task to reclassify them and in many cases reword them in order to avoid cross-references and repetitions. In addition, the Hydro-Electric Commission has introduced a great many new rules and enlarged on many of the National Electrical Code rules. Prominent among the new rules not found in the National Electrical Code are those necessary for the protection of life.

Discussion

The paper called forth from Mr. S. B. Hood, of the Toronto Electric Light Company, Ltd., and Mr. A. A. Dion, of the Ottawa Electric Company, the criticism that the rules contained a number of contradictions, notably with reference to the grounding of the neutral in any system in which it is stipulated that the neutral should have no fuses but be solid straight through. Elsewhere the rules call for switches and circuit-breakers for this neutral system. A switch is also required between the house service and the meter, thereby eliminating all possibility of a central-station company using any sealed service equipment such as is now extensively employed to guard against theft of energy. Another point brought out was that branch fuses should be rated at 10 amp instead of 6 amp, as called for in the Hydro-Electric rules, so as to permit the use of appliances on any lamp socket. Attention was called to the fact that although the Hydro-Electric Commission made up the rules it would be incumbent upon the municipalities themselves to make the inspection, in which case if there were a private plant in that town it would be subjected to the supervision of its competitor. At the suggestion of Chief Engineer Gaby, of the Hydro-Electric Commission, a committee consisting of Messrs. A. L. Mudge, of the Electric Power Company, Toronto; F. G. Clark, of the Toronto Electric Light Company, Ltd., and W. G. Angus, of the Dominion Power & Transmission Company, Ltd., Hamilton, was appointed to confer with the commission on the rules, which had been put out on a tentative basis.

are, of course, dependent upon insulation, aging, temper- divided the mediums into two classes, one in which the

Electricity on the Farm

With the advent of inexpensive protective equipment, of bi-metallic conductors which permit long spans and of more dependable and cheaper high-voltage transformers, it becomes possible to cut down investment in a rural distributing system and to go even to the use of steel conductors, using one conductor with a ground return for single-phase primary distribution in rural districts. A consideration of these conditions is important in getting after rural loads because, as pointed out by Mr. J. C. Parker, of the Rochester (N. Y.) Railway & Light Company, in his paper on "Electricity on the Farm," there is no justification for the same quality of service either with regard to continuity or close regulation in rural districts that is required in urban territory. In addition, the large obstacle of high cost of farm installation must be overcome. The actual installation must take the form of rugged, absolutely simple equipment capable of withstanding rough usage and keeping in operating condition without close follow-up from the maintenance department. The equipment must also be of a wide range of utility so that the same investment may serve a multiplicity of uses. While technical excellence justifies itself economically, in farm installations some other criterion must obtain, because, as pointed out by the author, in the case of a fodder-cutter rated at 2 tons, with energy at 5 cents per kw-hr. and labor at 15 cents an hour, the labor represented 18.6 per cent of the entire cost, the energy 26.2 per cent, and depreciation and interest 55.2 per cent. Therefore, no great loss will be incurred by the user of the apparatus if the efficiency of the equipment is very much lower, provided the investment cost is brought down. Mr. Parker also called attention to the prevailing literature used in soliciting farm business, the quality of which is such that it bespeaks a conviction that farms must be electrified on sentiment rather than as industrial propositions. Pruning of trees by means of a hot wire was among many of the suggested uses of electricity on the farm, and the author also hinted at the use of the electric motor as a remedy to farm labor troubles. In the opinion of the author, it is erroneous to try to supplant other forms of power by electric power instead of preaching electric power as a means of saving wastage. It is not that the electric motor will do more work at $1.50 a day than will the farm laborer, but that the electric motor can be induced to stay on the farm and be ready for work when wanted, while the farm laborer cannot. While the problems are chiefly those of the future, Mr. Parker emphasized the fact that in the preparing and obtaining farm business it will be necessary to break loose from some of the traditions in regard to line construction by making the lines that serve the farmers inexpensive through the use of small copper section, light structures and inexpensive protective apparatus, sacrificing, if necessary, closeness of regulation and to some degree perhaps continuity of service. The overloaded capacity of transformers will also have to be used and perhaps pushed to the limit. The wiring installations on the farm themselves will have to be of the most inexpensive sort, and the whole equipment of such a nature that the farmer will not have to tie up a large sum of money for one isolated function.

Discussion

Messrs. Maclachlan, Peeling and McClelland, of the Trenton Electric & Water Company, of Belleville, contributed to the discussion on Mr. Parker's paper. The Belleville company went after rural loads last fall and now has two lines in operation. At first the community plan was tried but afterward abandoned. Flat rates are successful in certain districts and meter rates in other sections. The speakers said it was bad policy to build the rural line before securing the business and that cheap and rugged equipment is desired. On installations ranging from 1 hp to 4 hp the cost approximates $110 for a 1-hp motor and wiring, $175 for 2 hp, $225 for 3 hp, etc. On one line 12 miles long the company has a connected load of 75 hp.

Service

In his paper on "Service," Mr. Stephen L. Coles, of the Society for Electrical Development, laid stress on its importance in the upbuilding of any public utility, because no other one business comes so near to the people as does that of the central station. The successful sales manager of a central station, he said, has a better grasp of the social, political and business conditions in his community than any one else, and the success of a central station not only as a public utility but as a business proposition carried on for profit is in direct ratio with the service it gives. At the present moment, he maintained, the public is quite sufficiently informed to demand and insist upon service, and the central station has no alternative but to give it or else suffer competition. Every point of contact between the company and a customer is an opportunity for service, and the manner in which any such opportunity is grasped is an exact demonstration of the company's ability to give service.

Discussion

In discussing the paper Mr. W. Maclachlan, of Belleville, called attention to an article in the May number of *Harper's Magazine* entitled "The Power That Serves" and suggested that the association issue reprints. Mr. G. W. Magalhaes, of Toronto, said that service should come before rates and drew attention to the fact that most large companies now act as consulting engineers in illumination, motor installations, etc. The Toronto Electric Light Company, Ltd., also has a repair force for emergency service which is on duty day and night, and Mr. McDougall, of that company, told how oftentimes the company stretches a point in doing something for nothing in order to satisfy the customer. This is especially true in removing grounds on interior wiring circuits. The discussion then turned to the relations of central stations to contractors, and Messrs. A. A. Dion, of Ottawa; D. H. McDougall, of Toronto; W. Ostrom, a contractor of Belleville, and W. H. Munro, of Peterborough, took part. Mr. Dion said that his company carries a complete line of supplies but does not do wiring. Mr. McDougall said the Toronto Electric Light Company no longer sells fixtures and does no wiring. It co-operates with the local contractors' association and last year turned over 300 customers to local wiremen. He said the good-will of the contractors is an important asset and hoped for much from the Society for Electrical Development in clearing up differences. Mr. Ostrom said his company maintains six branches and at first thought central stations were antagonistic. The trouble he found arose over bad wiring, and this was remedied by the contractor setting aside a man to attend to complaints of that sort. The revenue obtained from this work pays the wages of the man and nets a handsome profit in addition. In Hamilton, it was pointed out, the wiremen are opposed to the lighting company because it sells supplies, and it was suggested that a company could be guided in the question of whether or not it should handle supplies, etc., by referring to the rating of local contractors in Bradstreet's or other mercantile agencies. Mr. Dion said that in Minneapolis, Minn., the company has abandoned the sale of appliances of all kinds.

Pole-Type Transformers

In a paper entitled "Pole-Type Transformers" Mr. C. E. Sisson, of the Canadian General Electric Company, directed attention to some of the more important details entering into the design and structure of the modern lighting transformer both from an operator's and a manufacturer's point of view. He gave the essential features of a lighting transformer in the order of their importance as follows: safety, durability, economy of operation and first cost. The first three

are, of course, dependent upon insulation, aging, temperature rise, core loss, copper loss, regulation and magnetizing current. In the estimation of the author the insulation should be such that it will be practically indestructible. From an operating point of view reliability is of greatest importance, since upon it depends the continuity of service, with which goes the satisfaction of customers, while from an economic standard it cannot be ignored, as it determines the rate of depreciation that should be placed on the equipment. If the apparatus is to be more reliable, it is necessary to give attention to a better arrangement of parts and the selection of a better and more suitable method of insulation. The insulation must be free from and protected against absorption of moisture in addition to having dielectric strength sufficient to withstand normal strains of operation and test voltages required. This condition is obtained by drying the apparatus in a vacuum and filling it with a compound which will harden under normal conditions. Importance should also be attached to the question of uniform temperature in transformers. In speaking of the economy of transformer operation, the author pointed out that with the marked improvements in the quality of steel the losses in the present type of transformer have been materially reduced until for a given kva rating the transformer is the most efficient piece of electrical apparatus built. The improvements in the efficiencies at light loads illustrate clearly the fact of the reduction in core losses, while improvement in regulation is accounted for by the reduction in copper losses. A decided improvement has also been made in the regulation at low power-factors. This marked reduction in losses, combined with the better mechanical construction of the newer types of transformers, has made it necessary to place a very high depreciation value on the older apparatus installed. In the estimation of the author, this depreciation is more than offset by the decrease in the annual cost of core and copper losses coupled with the advantage of better continuity of service. He said it would be economical engineering on the part of central stations to replace many of their old transformers by newer and more efficient ones, even if the old transformers are still operative. Thus the depreciation charge to be placed against a transformer does not depend upon the natural life of the apparatus, but upon the time during which it can be profitably kept in service. Marked improvements cannot be reasonably anticipated, and while a more efficient transformer could be produced by increase in materials, any advantage in low losses would be offset by a higher cost since a decrease of 1 per cent in core and copper losses requires over 3 per cent increase in active material. The characteristics which should receive more careful consideration are long life with continued service.

Discussion

Messrs. S. B. Hood, of Toronto, and W. L. Bird, of Fort William, told of the troubles which had disappeared from their lines since they grounded the neutral. Heretofore it used to be the practice to go out and re-fuse both sides of the transformer after every storm. In Toronto the company has not lost a transformer in three years. Mr. A. L. Mudge, of Toronto, said his company employs pole-type transformers of the higher-voltage type, particularly for rural distribution work, with good results, and Mr. Sisson said 6600-volt and 11,000-volt transformers will be adopted more and more. Replying to questions of manufacturers as to the standardization of taps, it was brought out that taps are a great advantage in boosting voltage at times and in general central-station service and that it would be out of the question to discontinue them for manufacturing reasons.

CENTRAL-STATION ADVERTISING

Mr. D. H. McDougall, of the Toronto Electric Light Company, Ltd., in a paper on "Central-Station Advertising" divided the mediums into two classes, one in which the company comes in direct contact with the public and the other by printed advertising. The first he subdivided into five sub-topics as follows: Delivering the goods; courtesy to the public at every point of contact; direct personal canvass; periodical visits to consumers to solicit criticism and complaints, and prompt and cheerful attention to complaints of consumers by means of an efficient emergency force. The several methods of printed advertising the author classified in the following order of importance: Direct advertising, by which is meant a company magazine or house organ published monthly, circulars, letters, pamphlets, etc., sent direct to prospective customers or others it is desired to interest; daily newspaper advertisements; billboard, street car and electric sign advertising; weekly papers or magazine advertising; theater programs, charity and entertainment programs, etc. By means of attractive literature that will be read the author said more good can be done than by any other means provided the articles are true. The daily newspaper advertisement can be made effective if the reading public is sympathetic or interested in the company, but as a means of converting an antagonistic public it is of doubtful effect unless the papers themselves are fair or at least unbiased toward the company. A small antagonistic news item in the same edition as the company's advertisement will to a large extent neutralize the latter's effectiveness. The author pointed out the merits and demerits as advertising mediums of electric signs and billboards, street-car advertising and the other forms mentioned. On the whole, however, the best method, in the opinion of the author, of advertising the company's business is service, by which is meant delivering the goods in every branch of the organization with efficiency and courtesy.

A very general discussion on advertising methods followed the presentation of Mr. McDougall's paper. In Ottawa billboard advertising has been discontinued by the company. The Hamilton company has issued a four-page bulletin for three years, and the Toronto company has just begun the publication of a monthly bulletin for customers and the general public. Last year the Toronto company spent $20,000 in advertising, but line troubles invalidated most of it. The company is expending $3,000,000 on transmission lines and steam equipment to be in a position to give better service, and as soon as the work is complete a vigorous advertising campaign will be undertaken.

In a subsequent issue the papers and discussions covering the following subjects will be published: Graphic meters, integrating wattmeters with recording attachments, magnetite street lighting, flame carbon arc lamps, and electric vehicles.

Public Service Commission News

CALIFORNIA COMMISSION

The Railroad Commission has rendered a decision denying the petition of the Sierra & San Francisco Power Company for authority to intervene and to present evidence in connection with the application of the Oro Electric Corporation to enter a portion of San Joaquin County. The commission found that the complainant did not operate in the section affected and had no representatives at the hearing.

NEW YORK COMMISSIONS

Governor Sulzer has nominated as members of the Public Service Commission of the Second District Mr. Charles J. Chase, Croton-on-the-Hudson, to succeed Mr. Curtis N. Douglas, and Mr. William E. Leffingwell, of Watkins, to succeed Mr. Frank W. Stevens. Mr. Chase has been in the employ of the New York Central & Hudson River Railroad for twenty years, while Mr. Leffingwell is a hotel proprietor.

Current News Notes

Portola Illumination.—The Board of Supervisors of the city and county of San Francisco, Cal., has made an appropriation of $5,000 to provide for the special illumination of the city during the Portola celebration of next October.

* * *

Site of First Public Telegraph Office.—On July 4 on Seventh Street, between E and F Streets, N. W., Washington, D. C., there was unveiled a tablet marking the site of the first public telegraph office. This tablet was erected by the committee on permanently marking points of historic interest in the District of Columbia.

* * *

Chicago Home Rulers Still Active.—At its meeting of July 7 the City Council of Chicago adopted a resolution, introduced by Alderman Merriam, urging Governor Dunne to call a special session of the Legislature for the purpose of amending the law creating a state public utilities commission by introducing the original article providing for the municipal control of local utilities.

* * *

N. E. L. A. Exhibit Committee.—At a meeting of the exhibit committee of the National Electric Light Association held at Association Island, Henderson Harbor, N. Y., on July 8, Mr. James I. Ayer, of the Simplex Electric Heating Company, was elected chairman to succeed Mr. J. C. McQuiston. Mr. H. S. McConnaughy, 299 Broadway, New York, was re-elected secretary and treasurer.

* * *

Dazzling Automobile Head-Lamps Barred.—A new city ordinance in Chicago makes it unlawful for any person operating an automobile or other vehicle on the streets of the city to use any acetylene, electric or other headlamps the rays from which are intensified by any parabolic reflector or condensing lens, unless the lamp is shaded so that the light will not dazzle the eyes of other users of the highway.

* * *

Electrical Draftsman and Meter Inspector.—The State Civil Service Commission, Albany, N. Y., has arranged open competitive examinations for certain positions to be held in various cities throughout the State on July 26, 1913. Among the positions are those of electric meter inspector for the Public Service Commission at a salary of from $900 to $1,200, and of electrical draftsman in the office of the State architect at a salary of from $1,500 to $1,800. Applications for blanks can be obtained from the commission up to and including July 16.

* * *

Referendum Sought on Chicago Subway Question.—Mayor Harrison has asked the City Council of Chicago to authorize a referendum by the voters of the city in the election of next April on the question whether there shall be built (1) a downtown subway for the accommodation of the elevated roads to take the place of the present Union Loop and to be paid for from the city's traction fund or (2) a comprehensive subway system following the routes laid out in the report of the subway commissioners of Sept. 10, 1912. Tentative ordinances covering these two plans have been prepared.

* * *

Some Mile-a-Minute Electric Vehicles.—While as a purely speed machine the ordinary electric vehicle is hardly likely to compete with modern gasoline automobiles, Messrs. W. H. Watson and R. J. Mitchell in a paper before the recent London convention of the British Municipal Electrical Association point out, however, that a specially designed Baker electric has achieved a distance of 1 mile in a second less than a minute, its equipment including a twelve-cell battery weighing 300 lb. and a motor scaling 100 lb. Another experimental Baker car has a record of a mile in forty-two seconds to its credit. There might thus be a fair chance of an electric vehicle gaining a world's record for a mile journey if anything useful seemed likely to be gained by the result. The ordinary electric automobile, however, can accelerate more quickly than many other road vehicles. On a test made recently in the London streets a 6-ton battery bus showed an acceleraion of 4.5 ft. per second per second on the level—a figure 40 per cent in excess of the average value of this factor applying to London omnibuses.

* * *

Keeping the Wheels Going Round.—The feat of the juggler who keeps three or four balls in the air, all the while balancing a spinning plate on the tip of his nose, has its parallel in some of the problems which confront the construction engineer when he has to give uninterrupted service during plant reconstruction and replacements. Such a situation was involved in starting up the big Mississippi River water-power plant at Keokuk last month, for the old steam station from which the local community received its electrical energy stood at a level several feet below the surface of the water impounded by the new dam. Raising the water behind the dam preparatory to starting up the hydraulic units, therefore, apparently meant flooding out the steam plant, with an interval of two or three days during which neither plant would be operative. The dilemma was met, however, by throwing up an earth dike around the steam station and taking care of the seepage by pumps.

* * *

SOCIETY MEETINGS

Chicago Convention of Electric Vehicle Association.—As previously announced, the annual convention of the Electric Vehicle Association of America will be held in Chicago on Oct. 27 and 28. Mr. H. E. Niesz, manager of the Cosmopolitan Electric Company of Chicago, who is chairman of the Chicago Section of the association, will have general charge of local convention arrangements. Suggestions as to papers to be discussed may be sent to Mr. Niesz or to Mr. Harvey Robinson, 124 West Forty-second Street, New York, the national secretary of the Electric Vehicle Association.

* * *

Telephone Pioneers.—The third annual meeting of the Telephone Pioneers of America at Chicago, Oct. 16 and 17, will be addressed by Mr. N. C. Kingsbury, vice-president of the American Telephone & Telegraph Company; Mr. M. J. Carney, of the central group of companies at Chicago, and Mr. Thomas B. Doolittle, retired, of Branford, Conn. Mr. B. E. Sunny, president of the Chicago Telephone Company, is expected to make the welcoming address. The plan and scope committee in charge of the entertainment features consists of Messrs. B. E. Sunny, A. S Hibbard and Frank E. Ketcham.

* * *

Electrical Contractors' Association of Missouri.—The Electrical Contractors' Association of the State of Missouri is holding its thirteenth annual meeting at the City Club, St. Louis, to-day. A reception of visitors and breakfast at Union Station Hotel will be followed by a business meeting for members only, after which luncheon will be served at the City Club. This afternoon the members and guests will be taken in automobiles to the ball game and dinner will be served at the Sunset Country Club. Sunday afternoon, July 13, the members and guests will be taken for an automobile ride about St. Louis, and in the evening a buffet luncheon and refreshments will be served at the Century Boat Club. The contractors will leave St. Louis on Monday in time to arrive for the convention of the national association at Chattanooga, Tenn., on July 16.

A 40,000-hp Swiss Hydroelectric Plant

Development at Biaschina, in southern Switzerland, utilizing 870-ft. head of Tessin River to furnish energy for nearby electrochemical industries

THE Biaschina hydroelectric plant, recently completed in the south of Switzerland, is of interest not only by reason of its being one of the large electric stations in that region but also from the fact that its principal purpose is to furnish energy to electrolytic industries near by. Several of these electrochemical factories are now in operation, and the locality is rapidly becoming a center of industrial activity which will doubtless be increased in scope as time goes on.

Located in a mountainous region, the present plant makes use of the fall in the Tessin River between Lavorgo and Bodio, the turbine house being situated at the latter point. The St. Gotthard railroad follows the Tessin River in this region, which is an advantage both to the electric station and to the future industrial outlook of the district.

The promoter of the present hydroelectric and industrial project was the "Motor" Company of Baden, Switzerland. This corporation not only obtained the concession for the hydraulic and electrical work on the Tessin River but also purchased a considerable area of ground adjoining the turbine station at Bodio, with the intention of founding a center of electrical enterprise at this point. Accordingly the company proceeded to prepare the ground with this purpose in mind, not only carrying out the needed surface leveling work and installation of power lines, but also making railroad connection with the St. Gotthard system so that the latter's tracks will eventually connect the various electrolytic works installed at this point. The hydraulic works in the Tessin make available a potential energy supply which now reaches 40,000 hp at high-water periods, while the minimum supply is probably 25,000 hp.

ELECTROCHEMICAL APPLICATIONS OF OUTPUT

Three electrochemical plants are already installed in the neighborhood of the station, the first of these being the Diamantin works, which are a branch of the Rheinfelden enterprise and are designed for the production of carborundum. Another is the Gotthard works for the manufacture of ferro-silicon and like products, which were founded by the "Motor" Company together with a syndicate of German financiers. Lastly there is the Nitrum plant, backed by German and Swiss capital, which is engaged in the manufacture of nitric acid and other nitrogenous products from atmospheric nitrogen and oxygen. Other electrochemical enterprises are expected to be founded here in the near future, so that the local region will rank among the leading European centers for this class of production.

Besides the uses above outlined, the plant furnishes energy for a local interurban electric railway which runs from Biasca to Acquarossa and will be later extended as far as Olivone in order to open up this region and bring it within reach of the St. Gotthard system.

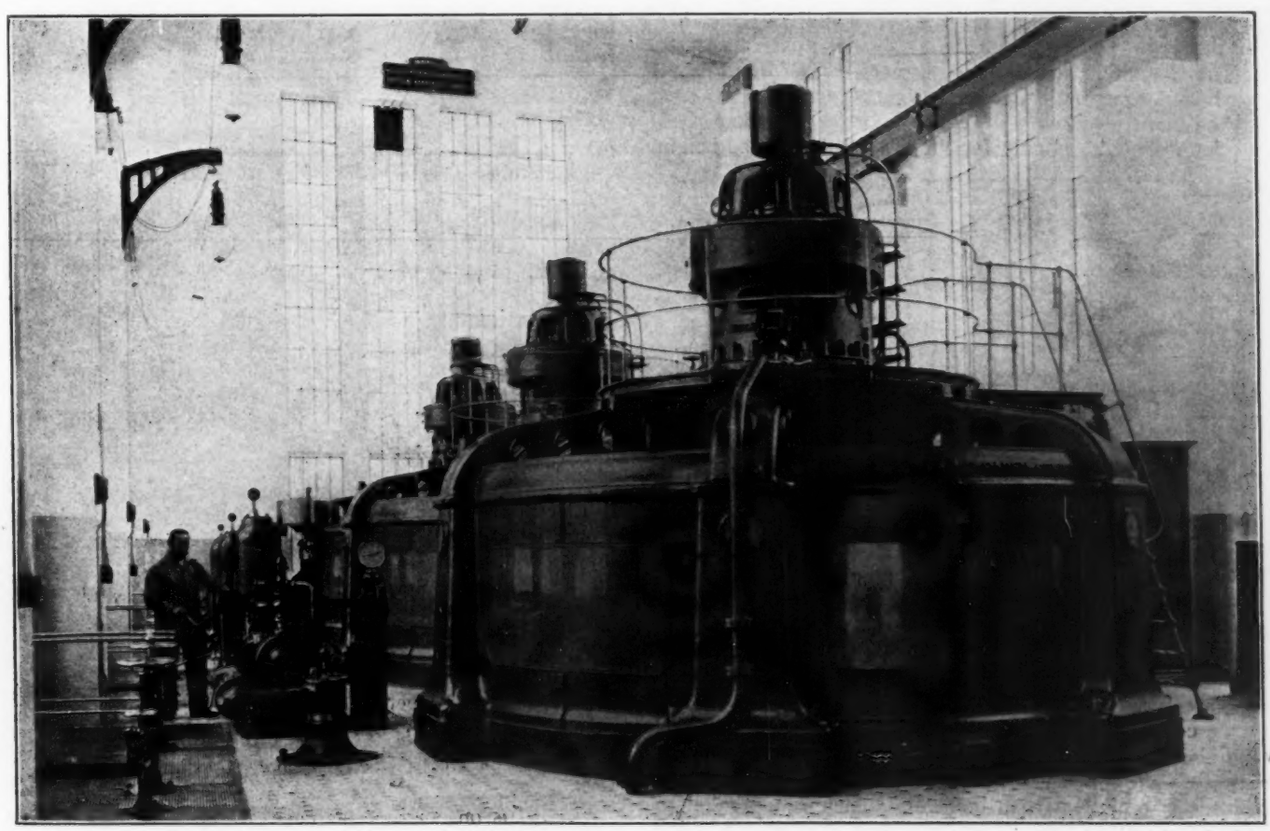


FIG. 1—INTERIOR OF GENERATING STATION AT BIACHINA

Dam, Flume and Tunnel to Turbine Intakes

The barrage or dam for the Biaschina plant is built across the Tessin River in the vicinity of Lavorgo. At one side of the structure is a settling basin or forebay which serves as the starting point of the flume leading down the river valley to the point where the turbine house is located. This flume is made up of rock-cut tunnel for the greater

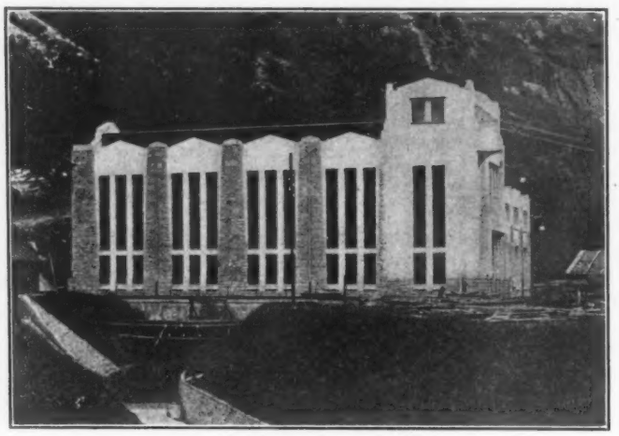


FIG. 2—POWER HOUSE NEARING COMPLETION

part of the distance, its total length being 5.4 miles. It is designed to deliver a maximum water supply of 4000 gal. per second, the rate of flow being 8 ft. per second.

The flume ends in an intermediate basin of considerable size lying above the turbine house and thus affording a reserve of 200,000 cu. ft. of water. From this receiving basin extends the pressure tunnel proper, which represents something of a departure from the usual form of intake by means of penstock tubes. In fact, the steep, rocky sides which overlook the turbine house made it almost impossible to carry the penstock down at the necessary slope, so that it was decided to use a rock-cut tunnel for the upper part of the work.

The Biaschina installation presents, therefore, a novel method of construction, at least as concerns the great height of the flume, about 600 ft., which is under pressure. Penstocks are employed only for the lower third of the height.

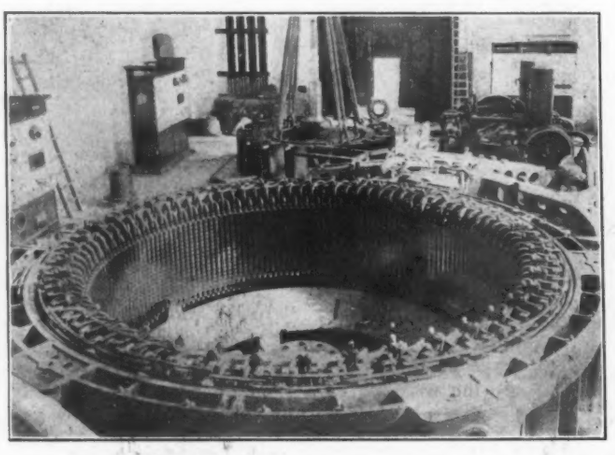


FIG. 3—STATOR OF ALTERNATOR

The pressure tunnel is lined with concrete and has a smooth surface finish of cement, the internal diameter being 9.3 ft. and the cross-sectional area 62 sq. ft., with a maximum flow of 4000 gal. per second. The flume connects to two penstocks, each 5.5 ft. in diameter, which run parallel to each other within a tunnel leading down through the valley to the station.

Four 10,000-hp Turbine Units

The four turbine units are mounted along the center line of the station, each penstock feeding a pair of these turbines. The units are of the vertical-shaft type and each is mounted in the usual way in a chamber beneath the machine floor. After leaving the turbine the water goes by way of the discharge passages into a common offtake conduit and thence by a 1300-ft. canal to the Tessin River. The available total head of water, measured between intake and tailrace levels, is about 870 ft., while the net fall, deducting losses, is 840 ft. to 850 ft.

The four turbines in the plant are of the Escher-Wyss Swiss type and are each designed to give 10,000 hp at their rated speed of 300 r.p.m., so that the machine capacity of the station totals 40,000 hp. Such turbines are able to stand individual overloads up to 12,000 hp without trouble.

The electrical equipment of the Biaschina station was furnished by the well-known Swiss firm of Brown, Boveri & Company, to which we are indebted for our present description of the plant. The principal electrical apparatus includes four three-phase alternators mounted on the turbines, as well as the switchboard outfit for the machines and for four outgoing feeders.

The alternators are of the rotating-field type and are designed to furnish 8800 kva at 80 per cent power-factor.

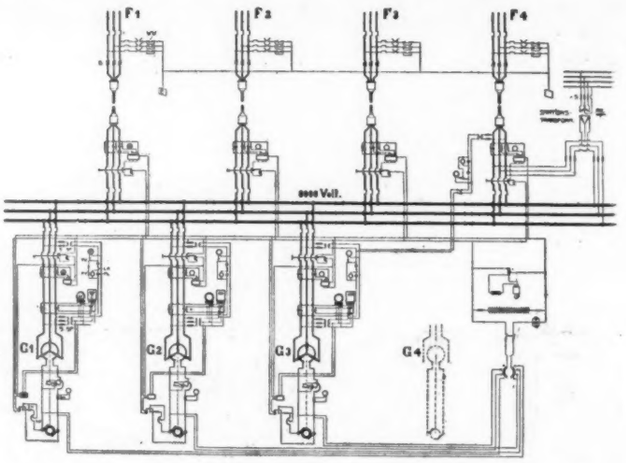


FIG. 4—DIAGRAM OF CONNECTIONS AT GENERATING STATION

They are also able to stand a 10 per cent overload for three hours, or a 25 per cent overload for thirty minutes. Working at the rated speed of 300 r.p.m., they deliver 8000-volt, 50-cycle, three-phase energy. The rotor, which is mounted on the turbine shaft, carries a set of twenty pole-pieces comprising the field members. On the shaft is fitted a heavy cast-steel hub which carries a series of Siemens-Martin steel rings, eighteen in number, and these latter serve as supports for the field pole-pieces, carrying the heavy strains due to centrifugal force. This method of mounting has been found to give very good results. Air spaces are left between the several rings of the series, and the incoming air passes through these spaces into the pole-pieces proper. These latter pieces are dovetailed into the steel-ring construction, as will be observed, and can be readily removed by taking out a key. The pole-pieces are made up of a main body of cast steel, with pole-ends, to the outer ends of which are dovetailed laminated-iron pole-faces. For the field-coil windings eighty turns of flat copper strips are used per pole.

Details of Machine Construction

The stators were built in three pieces in order to give proper facility for transportation and are fixed upon solid foundation plates from which they are removable. As usual, the laminated iron of the stator or armature is held

between end plates, and it is here made up in nineteen sections separated by 0.4-in. ventilating spaces. The armature has 180 slots of the full open type and the winding consists of lathe-wound coils insulated with mica. Sets of openings in the outer iron shell of the stator give access to the interior and these are fitted with sheet-metal covers. The slip-rings are mounted between the rotor hub and the button bearing of the machine, as will be noticed, while the exciter occupies the customary position above the top bearing.

The exciter is an eight-pole shunt-wound generator with auxiliary pole and is designed for an output of 75 kw at 220 volts. Air circulation is well carried out, the cooling air being drawn up from the underlying turbine chamber and, after passing through the active parts of the machine, being discharged at the top. The rotor shell itself serves as a ventilator for this purpose, and the air stream is properly directed by the use of guide pieces mounted in the machine. In this way the ventilation is so effective that the machine runs well below the guarantee figure of 45 deg. C. The entire weight of the machine, including the exciter and upper bearing, is about 100 tons, while the rotating part, inclusive of the shaft, weighs some 38 tons. Losses in the machine at full load and 80 per cent power-factor are as follows: Stator iron, 150 kw; stator copper, 37 kw; field copper, 55 kw; ventilation and bearing friction, 50 kw; total, 292 kw. Based upon the 7000-kw rating this gives an efficiency of 97 per cent.

8000-Volt Bus and Distribution Arrangement

The alternators work in parallel on a single set of 8000-volt busbars, from which there are led off three feeders, in addition to apparatus for a fourth line to be used eventually. On the busbars are mounted section switches for independently cutting out any one of the machines or feeders. Between each alternator and the busbar there is a three-pole automatic circuit-breaker, an instrument transformer for the machine voltmeter, the ammeter, wattmeter, phase voltmeter and pilot lamps, and a two-pole retarding relay for the automatic circuit-breaker. Opposite each alternator is a separate board which contains the low-tension switches, instruments and control devices, while the high-tension circuits are mounted in the basement below the machine-room floor. Connections to each feeder from the busbars are made through a three-pole automatic oil circuit-breaker, the instrument transformers used for the

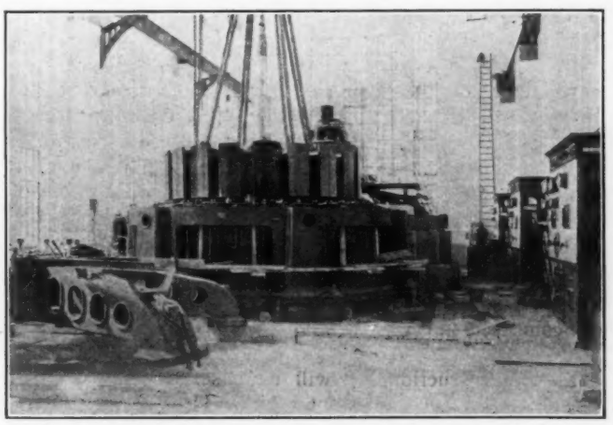


FIG. 5—PLACING ROTOR OF ALTERNATOR

feeder ammeter, and a three-pole retarding relay, the circuits running thence in three lead-covered cables to the lightning-arrester room. Cells here contain the apparatus for lightning protection of each phase of the outgoing line, including Siemens horn arresters, water resistances and choke coils. The four feeders are as follows: (1) Tie feeder connecting with the neighboring electric plant of Ticinetto; (2) supply to the Biasca electric railway; (3) feeder for the electrochemical plant; (4) feeder to be eventually installed.

Permanent Construction Plant at Dam Site

In order to carry on the work of rock drilling, water pumping, lighting, etc., during the construction of the plant

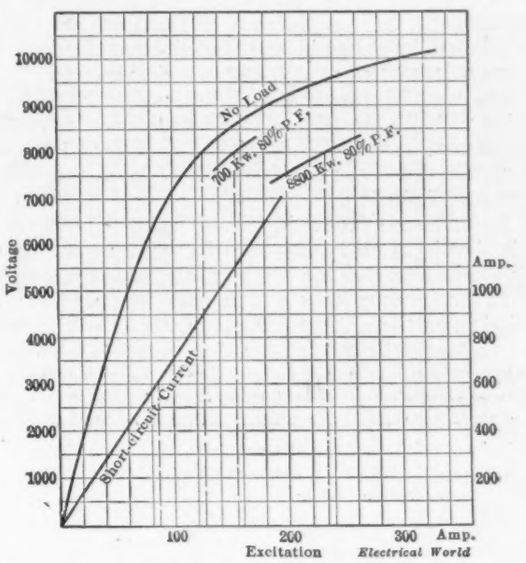


FIG. 6—CHARACTERISTIC CURVES OF A 8800-KVA GENERATOR

there was installed a small electric plant not far from the present station, which made use of the water of the Ticinetto mountain stream, a tributary of the Tessin River. At the outset it was decided to construct this development as a permanent plant so that it could be left in place instead of dismounting it after the work was finished. The Ticinetto plant utilizes a 550-ft. head of water, and the turbine house contains three turbine-alternator sets of the horizontal-shaft type.

The turbines run at 500 r.p.m. and are rated at 500 hp, being coupled to Brown-Boveri three-phase alternators. These machines are designed for an output of 420 kva at 80 per cent power-factor and deliver 8000 volts at a frequency of 50 cycles. Two power lines leave the station, one going to the town of Lavorgo for local use while the second line connects with the main station by the feeder already mentioned.

Phase Compensation—II.

By Val. A. Fynn

The first instalment of the article entitled "Phase Compensation," by Mr. Val. A. Fynn, appeared in the *Electrical World* of July 5. In the following columns the discussion of the subject is resumed.

In any alternating-current motor the phase of the back emf is bound to follow the phase of the exciting flux. If then the phase of the exciting flux is altered relatively to the phase of the working emf, then the phase of the back emf will be correspondingly displaced relatively to the working emf. In the synchronous motor the phase of the exciting flux (and therefore the phase of the back emf) is displaced with reference to the phase of the working emf whenever the synchronously revolving field poles are momentarily accelerated or retarded, immediately resuming their synchronous rotation in this altered relative position.

Since by changing the phase of the exciting flux of an alternate-current motor relatively to the phase of the working emf, one can change the phase of its back emf, and since such a change in the phase of the back emf brings

about a change of phase between the working or terminal emf and the current taken by the motor, therefore, in an alternating-current motor one can control or adjust the phase relation between terminal voltage and current by controlling or adjusting the phase of the exciting flux relatively to the phase of the terminal emf. The manner in which the phase of the exciting flux is adjusted is clearly immaterial. In the synchronous motor this adjustment is brought about by a mechanical displacement of the field poles. It will be shown in what follows that the same thing can be achieved electrically, instead of mechanically.

It can well be assumed that the reader is thoroughly familiar with the electric magnetic and torque relations in direct-current machinery, but it seems appropriate to review certain conditions that have a bearing on the problems now under discussion.

If the armature shown in Fig. 17 were a perfect one—that is, devoid of all losses—then its speed would increase, under the influence of the working emf, until the generated back emf e_1 exactly equaled the impressed working emf. At this instant the current I would become zero and energy would no longer be taken from the source 35. The speed can obviously never exceed the value at which e_1 equals e_2, for the reason that e_1 would then exceed e_2 and the motor would be called upon to return energy to the source 35. This is impossible unless the machine is driven by a prime mover of some sort and ceases to operate as a motor. The ideal speed at which the back emf equals the working or

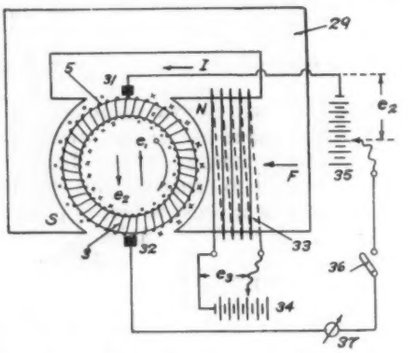


FIG. 17—SEPARATELY EXCITED DIRECT-CURRENT MOTOR

terminal emf is never reached in practice, for the reason that perfect motors do not exist—all of them require a certain amount of energy even to keep them running at no load. In practice the speed will increase until the difference between the working and the back emf has been reduced to just that value which is sufficient to drive through the resistance of the armature circuit enough current to cover the no-load losses of the machine. This condition is illustrated by the vector diagram shown in Fig. 18, which has been prepared on the assumption that 5 amp at 25 volts is sufficient to keep the motor in question running light. Under these conditions the value of the back emf at no-load speed must be 20 volts and its direction must be exactly opposite to that of the working emf. The resultant of these two components must necessarily coincide with the larger and is, therefore, of the same direction as e_2. This resultant thus becomes equal to 5 volts, which voltage will force the required 5 amp through the resistance of the armature circuit, which is supposed to be 1 ohm.

Since the magnitude of the emf e_1 generated within the armature by rotation in the exciting flux F depends on the speed and on the magnitude of the flux, it will be clear that the speed of the machine will change when the magnitude of the impressed emf e_2 or when the magnitude of F is changed. If e_2 is increased, then the difference between e_2 and e_1 will become larger, the machine will take more current and will accelerate until a speed is reached at which the difference between e_2 and e_1 is again only just large enough to cover the losses in the machine itself, or to enable the latter to deal with its load. If e_2 is decreased, the reverse will take place because the difference between impressed and back emf will momentarily decrease, thus cutting down the current taken by the motor, reducing the motor input, and consequently allowing the load to decrease the motor speed. This speed will diminish until the difference between e_2 and e_1 has again reached a value sufficient to drive enough current through the armature for the machine to perform its duty. Similarly, if the exciting flux is increased, the back emf will momentarily rise, thus retarding the armature, and the speed will drop until equilibrium is re-established. If the exciting flux is decreased, then the speed of the motor will rise. But if both the working emf e_2 and the exciting flux F are increased or decreased in the same proportion, then the speed will remain practically unaltered. Thus if e_2 and F are doubled, then e_1 will immediately be doubled because of the doubling of F, and it will not be necessary for the armature to alter its speed materially in order to preserve a constant difference between e_2 and e_1. The same argument holds true in case of a proportional reduction of both e_2 and F.

These considerations at once suggest that the machine shown in Fig. 17 is capable of operating on an alternating circuit, and it is easily seen that the diagram shown in Fig. 18 will, under certain conditions, illustrate the operation of the machine on alternating current quite as accurately as it illustrates its operation on direct current. It is known that alternating emfs and currents vary periodically, increasing from a zero value to a positive maximum, decreasing to zero, rising to a negative maximum, and again decreasing to zero. If alternating currents are applied to the machine shown in Fig. 17 and it is found possible to cause the back emf e_1 to oppose the impressed emf e_2, at every instant, as shown in Fig. 18, then this figure will illustrate the conditions obtaining in the alternating-current-fed machine at some particular instant, and can be made to apply to any other instant by merely changing its scale.

When dealing with direct currents one is concerned only with the direction and the magnitude of the currents and emfs involved, but as soon as alternating currents are made use of, then the frequency of the currents, fluxes and emfs and also their time-phase relation must be considered. While it is true that the diagram in Fig. 18 will correctly represent the conditions in the machine shown in Fig. 17 when operated with alternating currents, in case it is found possible to cause the back emf e_1 always to be of opposite direction to the working emf e_2, yet it is not at once apparent how this condition can be secured. In order to ascertain the possibilities in this direction, consider Fig. 19, which is intended to represent the same machine as that illustrated by Fig. 17, but does so in a more diagrammatic manner. Thus the armature winding of Fig. 19 is merely indicated by a circle 5 and only part of the field magnet 29 is shown. The operation as a motor of the machine shown in Fig. 17 or Fig. 19 depends on its ability to generate within its armature a counter emf e_1 capable (at every instant) of opposing the working emf impressed on the armature brushes. If this working emf is an alternating one, then the back emf must also be an alternating one and must have the same frequency as the working emf. The first question which arises concerns the frequency of the exciting flux F. Given a flux F of a certain frequency, how will the frequency of the emf generated in the armature 3 and appearing at the brushes 31, 32, be related to the frequency of F and how will it vary with variations in the speed of rotation? The answer can be easily ascertained with the help of the simple arrangement shown in Fig. 19, where the field winding 33 is connected to the battery 34 through the adjustable resistance 38 and the reversing switch 40. Let the armature winding 5 be revolved in any desired direction, say counterclock, and let the magnet 29 be so excited that the flux F is directed from right to left, then it is

known that an emf e_1 will appear at the brushes 31, 32, the magnitude of which will be constant as long as F and the speed are constant. Now decrease F—for instance, by moving the contact 39 so as to include more and more of the resistance 38 within the exciting circuit—and it will be found that e_1 will diminish, even though the speed is kept constant. When the exciting circuit is broken and F has become zero, it will be observed that e_1 is also zero. Now reverse the connections between the battery 34 and the exciting winding 33 by means of switch 40 and gradually increase the flux F by cutting out more and more of the resistance 38. It will be observed that e_1 will increase in magnitude, but in the opposite direction, although the direction of rotation has not been altered. If the magnitude of F, as well as its direction, be periodically varied by moving contact 39 and reversing switch 40, then it will be found that e_1 will also vary periodically and will go through the same cycles through which F is obliged to go by the manipulations of 39 and 40. These considerations, therefore, show that the emf appearing at a set of stationary brushes suitably disposed on a commutated winding 5 revolving within an alternating field F will alternate with the same frequency as the field; its magnitude depends on the speed of rotation and on the magnitude of the field in which it rotates.

It is easy to construct an apparatus which will close the circuit of the exciting winding 33 by throwing switch 40 upward, gradually cutting out all the resistance 38 by moving contact 39 to the left, thus increasing the exciting current i_3 to its maximum, then moving contact 39 to the right and decreasing i_3 to zero, reversing the current through 33 by throwing switch 40 downward, moving contact 39 to the left, increasing i_3 to its maximum, again reducing i_3 to zero by moving 39 to the right, and so on. While these operations are being performed the flux F would rise from zero to a positive maximum, fall back to zero, reverse its direction, increase to a negative maximum, and return to zero. One form of a mechanical device which will perform the above functions is shown in Fig. 20. It is so arranged that for each revolution of the handle H the current i_3 will twice become zero, at points 1 and 3, and will twice reach a maximum, at points 2 and 4. Under these conditions the flux F will go through one complete cycle for every one complete revolution of the handle H, and the number of cycles through which F will go within one second will depend on the number of revolutions made by the handle within that time. The variations of the emf e_1 during every revolution of the handle H, and assuming a clockwise direction of rotation of the armature winding 5, can then be represented by the full line curve e_1 of Fig. 28. While the handle H is turned through one complete revolution, the emf at the brushes 31, 32 will trace that part of the curve e_1 which is located between the points 2 and 2′ and so on. If the direction of rotation of the armature winding 5 is reversed, then the emf at the brushes will be reversed and will trace the dotted counterclockwise curve e_1 shown in Fig. 28.

Assume now that two batteries and two mechanical devices identical with the one just described and illustrated in Fig. 20 are provided and that each is placed in the hands of a separate operator. Let operator A set the pace with the device indicated in Fig. 21 and assume that he chooses to revolve his handle H_1 at a constant rate of 300 r.p.m., thus varying the emf at the terminals of his apparatus, according to the curve e_2 shown in Fig. 25. If to B is given the task of producing, with the help of his apparatus which is indicated in Fig. 22, a curve identical in shape and coincident at every instant with e_2 of Fig. 25, then he must, to begin with, revolve his handle H_2 at the same constant speed of 300 r.p.m.; the fulfilment of this one condition is not sufficient, for though B will thereby trace a curve of the same shape as that shown in Fig. 25, yet the two curves will not necessarily coincide in time, unless B takes additional precautions. Thus, while the curve traced by B has exactly the same shape as that traced by A, yet the former may not pass through its zero values at the same instant as does the curve traced by A. Further, even if both curves do pass through their zero values simultaneously, it is not said that they will simultaneously reach maxima of equal sign. In order that B may exactly duplicate the curve e_2 produced by A, and duplicate it at every instant so as to make the two coincide in time, he must revolve the handle H_2 not only at the speed at which H_1 is rotated but also in such a way as to perform, at every instant, exactly the same operations as are performed at that instant by the handle H_1. In other words, the two handles must not only revolve synchronously, but they must always be identically placed in space. Thus, when the handle H_1 is in its position 2, the handle H_2 should be in its position 2; when H_1 is in its position 3, H_2 should be in its position 3, and so on. These conditions may be briefly summarized by stating that in order to obtain two curves coinciding at every instant in direction, the two handles must revolve synchronously and co-phasedly.

Had B had the task of producing, with his apparatus, a curve with instantaneous values always equal but opposed to the instantaneous values of e_2 of Fig. 25, then he would have been obliged to revolve H_2 synchronously with H_1, as before, but to keep the former always in space opposition to the latter, the two handles then revolving in such a way that when H_1 is in its position 4, H_2 is in its position 2, and with H_1 at 1, H_2 should be at 3, and so on. A correct position of H_2 for the position of H_1 shown in Fig. 21 is shown in Fig. 22 by dotted lines. This may be briefly ex-

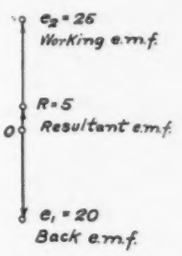


FIG. 18—PHASE DIAGRAM APPLYING TO THE OPERATION OF THE MOTOR SHOWN IN FIG. 17

pressed by stating that in order to produce two curves opposing each other in direction at every instant, the two handles H_1 and H_2 must stand in phase opposition and must revolve synchronously.

Since synchronous and co-phasal rotation of the levers H_1 and H_2 produces curves always coinciding in time (and direction), and since synchronous rotation of H_2 when displaced by 180 deg. in space from H_1 gives curves displaced in time by 180 deg. (and therefore always opposite in direction), then it is clear that synchronous rotation of the levers H_1 and H_2, when displaced in space by an angle of 90 deg. from each other, will yield two curves identical in shape but displaced in time by 90 deg.; that is, by an angle corresponding to the space displacement of the two levers. Such curves would assume the relative positions occupied by the curves e_2 and e_3, shown in Figs. 25 and 26 respectively.

Assume, further, that the operator A impresses the emf e_2 generated by his apparatus and the variations of which are shown in Fig. 25 upon the brushes 31, 32 of the motor shown in Fig. 17, and that operator B has the task of producing an emf e_3 which, when impressed on the field winding 33 of said motor, will enable the revolving armature winding 5 of the latter to generate at the brushes 31, 32, a back emf e_1 the instantaneous values of which are at every instant of nearly equal magnitude but of opposite direction to those of the working emf e_2. In order to fulfil these conditions it will be necessary for operator B to revolve the handle H_2 at the same speed as A revolves the handle H_1, and to keep H_2 throughout every revolution in

such space position relative to H_1 as will insure at every instant phase opposition between e_2 and e_1, it being understood that e_1 will appear only at the brushes 31, 32, after the motor has begun to revolve. It will soon be found that the relative space positions of H_1 and H_2 for which the above conditions are fulfilled are those shown by full lines in Figs. 21 and 22. In other words, it will be necessary for B to put his emf e_2 through its cycle sooner than e_2 is put through its cycle by A. This time difference in favor of e_2 is necessary in order to compensate for the time lag which prevails in the exciting circuit 33 between the emf e_3 applied to its terminals and the current i_3 in that circuit in response to e_3. This time lag is non-existent as long as the exciting emf e_3 is constant, but makes its appearance as soon as said emf is made to vary rapidly. It is due to the inertia or inductance of the circuit 33, which prevents the current i_3, and therefore also the flux F which is in time-phase with i_3, from instantaneously following the changes of the impressed emf e_3. It is known that a circuit of this description shows a time-lag of 90 deg. This fact is also expressed by saying that in an inductive circuit the magnetizing current i_3 lags by 90 deg. in time behind the impressed emf e_3. The conclusion is therefore reached that in order to operate the motor shown in Fig. 17 with alternating currents, in such a way as to secure a back emf e_1 which opposes the working emf e_2 at every instant, in the manner shown in Fig. 18, it is necessary to impress on the

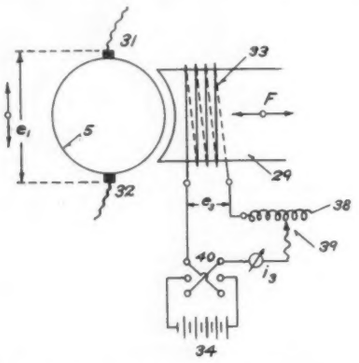


FIG. 19—COMMUTATOR GENERATOR EXCITED BY CURRENT VARYING IN MAGNITUDE AND DIRECTION

field winding 33 an emf differing in time-phase by 90 deg., or thereabouts, from the emf e_2 impressed on the armature brushes.

It is, of course, well understood that emfs such as e_2 and e_3 of Figs. 25 and 26 can be readily obtained from ordinary alternators, instead of making use of an arrangement such as is indicated in Fig. 20, but the conclusions reached with the help of this primitive apparatus hold good when it is replaced by ordinary alternators. If two separate alternators are made use of for the purpose of feeding energy to the motor shown in Fig. 17, then their field poles must show the space displacement indicated as suitable for the handles H_1 and H_2 in Figs. 21 and 22, on the assumption that the armature windings of these alternators are identically placed in space. Instead of making use of two such alternators it would naturally be much simpler to use a two-phase machine in which one set of field poles acts on two sets of armature windings displaced in space by 90 deg., as are the handles H_1 and H_2 in Figs. 21 and 22. In this case the armature winding 5 of the motor shown in Fig. 21 would be fed from one phase and its field winding 33 from the other phase.

Figs. 26, 27 and 28 indicate the time relation between the alternating emf e_3 applied to the terminals of the exciting winding 33, the exciting current i_3 in that winding, the exciting flux F due to i_3, and the emf e_1 (back emf) generated at the brushes 31 and 32, for either direction of rotation of the armature winding 5. These relations are expressed with equal clearness by means of the phase diagram shown in Fig. 23. It is known that owing to the self-induction, or inductance, or inertia, of the exciting circuit 33, the exciting current i_3 will lag by 90 time-deg. behind the exciting emf e_3. This condition is shown in Figs. 26 and 27 by starting the curve i_3 at the point 2, whereas the e_3 curve is started at the point 1. While the curve e_3 falls from its positive maximum at the point 2 to its zero value at point 3, the curve i_3, representing a current lagging 90 deg. behind e_3, will rise from a zero value at point 2 to its positive maximum value at point 3, and will fall to a zero value at point 4 while the emf curve e_3 rises to its negative maximum. It is as if curve e_3 were traced by the movement of the handle H_2 of Fig. 22, while curve i_3 is traced by another handle (H_1 of Fig. 21) coupled to H_2 but displaced therefrom by 90 deg. against the direction of rotation.

With these remarks in mind, Fig. 23 will be easily understood, for the various vectors shown thereon may be thought of as handles, such as have been described in connection with Figs. 21 and 22, which revolve synchronously while preserving the relative positions occupied by the various vectors shown in Fig. 23, or in any other similar vector diagram. When the emf e_3 is impressed on the field winding 33, the current i_3 lagging 90 deg. behind e_3 is produced, and the latter generates an alternating flux F, which is practically in time-phase with that current. As long as the armature winding 5 is at rest, no emf will appear at the brushes 31, 32. If that armature is, however, revolved, then the emf e_1 appearing at the brushes will be of same frequency as the exciting flux F, and of the same direction as F, or of a direction opposed to that of F. The armature may be so wound that, for a clockwise rotation, the direction of e_1 will coincide with the direction of F. If that is the case, then the direction of e_1 will be opposed to that of F should the armature be revolved in a counterclock direction. All this is expressed in the vector diagram 27, in which the curved arrow indicates the direction in which the handles or the vectors revolve, that is, in which time is measured. If the vector marked e_3 stands for the exciting emf, then the vector i_3, representing the exciting current, as well as the vector F, representing the motor flux, must, according to Figs. 26 and 27, lag 90 time-deg. behind e_3. According to Fig. 28, the vector e_1, representing the emf generated in the armature, must either be of same direction as the vector F or of a direction opposed to it, according to the direction of rotation of the armature. Some little time has been devoted to the explanation of the interrelation between the curves shown in Figs. 26, 27 and 28 and the vector diagram shown in Fig. 23, for the reason that such vector diagrams offer an extremely convenient manner of studying alternating-current phenomena, are really based on surprisingly simple conceptions, and must constantly be used throughout this paper.

The conclusions arrived at so far may be summarized as follows:

(1) A shunt-wound direct-current motor will always revolve in such a direction that the emf generated in its armature by rotation in the exciting field and appearing at its brushes will be of opposite direction to the working emf impressed on the brushes.

(2) The maximum speed at which a shunt-wound direct-current motor will run at a given load is governed by the condition that for any load the magnitude of the back emf must differ from the magnitude of the working emf by an amount sufficient to force through the resistance of the armature a current of sufficient magnitude to deal with the load on the motor.

(3) If in a shunt-wound direct-current motor the exciting flux is varied at the same rate as the working emf, or if both are simultaneously reversed, then neither the speed nor the direction of rotation of the motor will change.

(4) If the working emf and the exciting flux of a shunt-

wound direct-current motor are rapidly varied through the whole range of values comprised between a positive and a negative maximum, then, according to 3, the machine will continue to run in one direction and at a constant speed; from which it is seen that such a motor can be operated with alternating currents.

(5) In order to operate a shunt-wound motor with

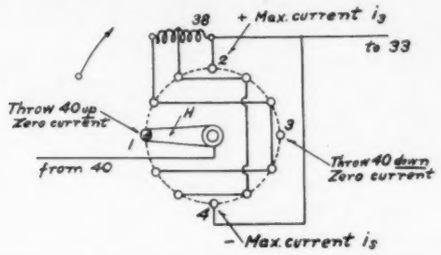
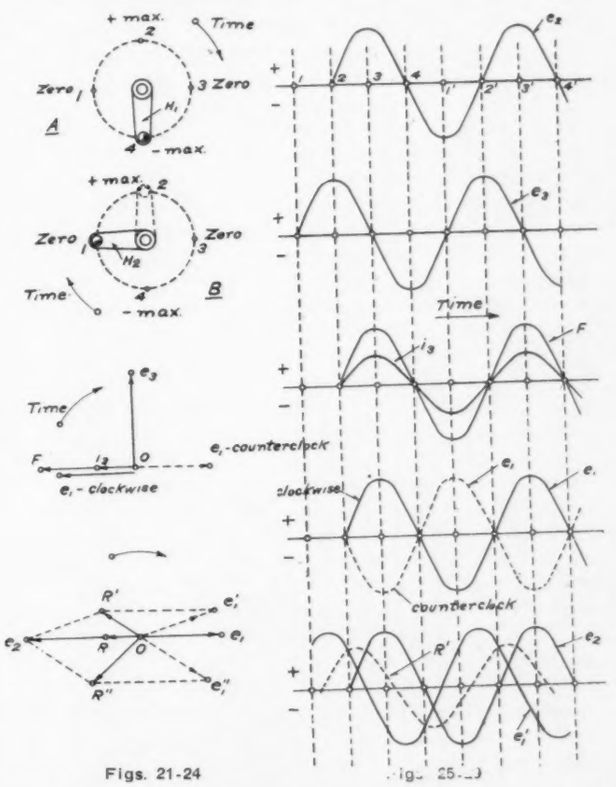


FIG. 20—APPARATUS FOR PROGRESSIVELY CHANGING THE MAGNITUDE AND DIRECTION OF THE CURRENT TAKEN FROM A BATTERY

alternating current in such a manner that the back emf is always almost equal to the working emf but always opposed to it in direction, it is necessary, owing to the inertia or inductance of the field magnets, to impress on the latter an emf differing in time-phase by about 90 deg. from the working emf. If these conditions are fulfilled, then the vector diagram in Fig. 18 will correctly represent the conditions obtaining at a particular instant in a (shunt) motor whether operated by direct or by alternating currents.

The phase diagram shown in Fig. 18 is again reproduced in Fig. 24, of which it forms a part, and the statement may here be repeated that, when in a shunt motor operated by alternating currents the phase of the exciting emf e_3 is so chosen that the back emf e_1 is always of opposite direction to the working emf e_2, then their resultant R will be of same phase and of same direction as e_2. This resultant R always determines the phase and magnitude of the current taken by the armature of the motor. The foregoing discussion has clearly shown that it is just as easy so to select e_3 that the back emf e_1 will not be opposed to e_2 at every instant. Suppose, for instance, that the operator A, to whom reference has already been made, works the handle H_1 of Fig. 21 so as to produce the working emf (e_2) shown in Fig. 25 and that this emf is impressed on the brushes 31, 32 of the armature of the motor shown in Fig. 21; then the operator B should work the handle H_2 of Fig. 22 synchronously with H_1 and always keep it 90 deg. ahead of H_1, as shown by full lines in Fig. 22, in order that the back emf e_1 generated at the brushes 31, 32 by a counterclock rotation of the armature (see Figs. 25 and 28) may at every instant oppose the working emf e_2. Now let operator B move his handle H_2 synchronously with H_1, but only keep it 45 deg. ahead of the latter; then the emf e_3 generated at B will lead e_2 of Fig. 25 by only 45 deg., its first zero value falling midway between the points 1 and 2 and its first positive maximum value falling midway between the points 2 and 3. Consequently, the dotted curve e_3 of Fig. 28 will have its first zero value midway between the points 2 and 3 and its first negative maximum midway between the points 3 and 4. Transferring this curve e_3 to Fig. 29 and marking same e'_3 will show that while e'_3 still opposes e_2 during three-fourths of the time occupied by half a cycle, yet it is of the same direction as e_2 during the remaining quarter of each half cycle, and it is quite clear that now the resultant of e_2 and e_1' cannot possibly coincide with either of these emfs. This resultant can always easily be ascertained by arithmetically adding the instantaneous values of e_2 and e_1' for a number of points distributed over a complete cycle. This addition has been carried out in Fig. 29 and its result is shown by the curve marked R'. It will be observed that R' reaches its maxima at a time when neither e_2 nor e_1' is at its maximum value, thus showing that R' differs in time-phase from e_2 as well as from e_1'. Remembering that in Fig. 29 time is measured from left to right, it is seen that R' reaches its positive maximum ahead of e_2 and therefore leads e_2, whereas it reaches its positive maximum after e_1' has reached its corresponding value, and R' therefore lags behind e_1'. This same thing can be even more clearly indicated by means of a vector diagram. The vectors e_1 and R of Fig. 24 have already been discussed, and show the conditions which obtain when the back emf opposes the working emf all the time. That same diagram, however, shows what happens when the back emf reaches its maxima too early or too late, as is the case in Fig. 29. Thus the vector e_1' represents a back emf which reaches its maxima somewhat later than e_1, but which is only about 20 deg. behind time, instead of 45 deg. as was assumed to be the case in Fig. 29. In order to find the phase relation of the resultant of e_2 and e_1' with respect to e_2, it is necessary merely to construct a parallelogram two sides of which are made equal to e_2 while the two others are made equal to e_1', as shown in Fig. 24. The resultant vector R' of Fig. 24 then indicates both the magnitude and the phase of the resultant emf R' which is responsible for the phase and magnitude of the current through the armature of the motor. These remarks will make it obvious that in case the back emf reaches its maxima too early, as indicated by the vector e_1'' of Fig. 24, then the resultant R'' will lag behind the working emf e_2 instead of coinciding with it as is the case when the phase



FIGS. 21 TO 29—TIME-PHASE RELATIONS BETWEEN THE WORKING AND THE BACK EMFS IN AN ALTERNATING-CURRENT MOTOR AND THEIR INFLUENCE ON ITS POWER-FACTOR

of the back emf exactly opposes the phase of the working emf, or instead of leading the working emf as is the case when the phase of the back emf lags behind the phase of the working emf.

The diagram in Fig. 24 really discloses the secret of phase compensation. If the phase of the exciting emf e_3 is so chosen relatively to the phase of the working emf e_2

that the back emf e_1 is of exactly opposite phase to the working emf, then the resultant emf R in the armature circuit of the motor will be in time-phase with the working emf e_2. These conditions secure operation at unity power factor in case the motor is an ideal one and its armature reaction is neutralized, for then the armature current will be in time-phase with the resultant R in the armature cir-

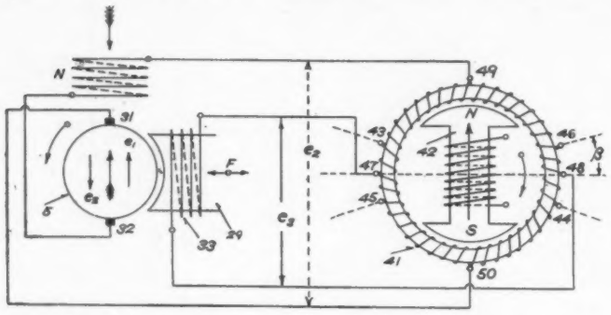
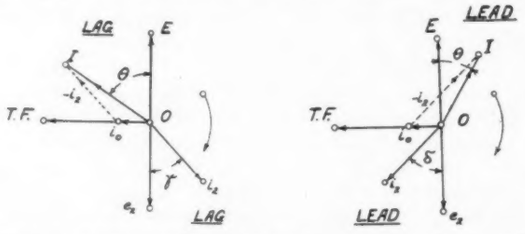


FIG. 30—ALTERNATING-CURRENT SHUNT CONDUCTION MOTOR OPERATED FROM A TWO-PHASE GENERATOR

cuit. But, in practice, the leakage fluxes cause the current to lag a little behind R, even when the armature reaction is neutralized, and if it be desired to cause an alternating-current motor to operate with a unity, or even with a leading, power-factor, all that it is necessary to do is to change the phase of e_1 so as to cause the phase of the back emf to lag behind the phase of the working emf by more than 180 deg., or, which comes to the same thing, to lead e_2 by less than 180 deg., in which case the resultant emf R in the armature circuit of the motor will lead the working emf e_2. This resultant R can always be made to lead e_3 sufficiently to cause the armature current either to coincide in phase with or to lead e_2.

The method of producing alternating emfs described in connection with Figs. 19, 20, 21 and 22 merely affords a convenient manner of explaining the various phenomena involved, but is by no means practical. In practice a shunt alternating-current motor would preferably be operated from a two-phase alternator, the connections being such as shown in Fig. 30. The armature winding 5 is provided with the brushes 31, 32 and is connected by way of these brushes in series with the neutralizing winding N, which is so disposed, connected and dimensioned as to cancel the armature reaction flux by producing from the stator an equal and opposite flux. This is indicated by the feathered arrows in Fig. 30. This motor armature circuit is connected to the points 49 and 50 of the generator armature winding 41, forming part of a two-phase alternator, the revolving field magnet of which is indicated at 42. The field winding 33 of the motor is also fed from this two-phase alternator; the connections shown indicate that the emf e_3 derived from 41 at the points 47 and 48 and impressed on the field circuit will differ by just 90 time-deg. from the emf e_2 derived from 41 at the points 49 and 50 and impressed on the armature circuit. From an earlier discussion it was learned that the vectors e_1, e_2 and R of the vector diagram of Fig. 28 correctly represent the conditions existing in the motor of Fig. 30 when the latter is connected to the alternating-current generator in the manner shown. The alternator connections of Fig. 30 show that for the position of the field magnet indicated in that figure e_2 is at a maximum while e_3 is zero, and that the two, therefore, differ in time-phase by 90 deg. They are consequently correctly represented as to phase difference by the vectors e_2 and e_3 of Fig. 31. From Fig. 23 it is seen that for a counterclock rotation of the armature e_1 will always lead e_3 by 90 deg. In Fig. 31 e_1 will, therefore, be exactly opposed to e_2. Because e_2 is always larger than e_1 the resultant R of the two will coincide in direction with e_2, and because the armature circuit comprising the neutralizing winding N and the armature winding 5 is not entirely devoid of self-induction, the current I produced in that circuit, under the influence of the resultant R, will lag behind the latter by a small angle α. Because R coincides with e_2, then the armature current I will also lag behind e_2 by an angle θ, which in this particular instance is equal to α. This diagram shows that the practical motor illustrated in Fig. 30, when subjected to quadrature emfs, must operate with a lagging current in the armature circuit.

The discussion of Fig. 24 has shown that in case the back emf e_1 is caused to reach its maxima a little later than the working emf e_2—in other words, if the back emf is made to lag a little behind the working emf, somewhat in the manner shown by the vector e_1' of Fig. 24—then the resultant in the armature circuit can be made to lead the working emf. This condition of things can be easily secured with the help of an alternator such as shown in Fig. 30, provided the armature winding 41 of the latter can be tapped at different points. The discussion of the motor shown in Fig. 19 has shown that a change in the phase of the exciting emf e_3 will always bring about a corresponding change in the phase of the back emf, for the reason that the two must in every case differ by about 90 time-deg. Thus, if instead of taking the exciting emf e_3 from the points 47 and 48 of the alternator, which are displaced by exactly 90 space-deg. from the points 49 and 50 of the latter, this excitation were taken from the points 45 and 46 of that machine, which are displaced by less than 90 space-deg. from the points 49 and 50, then the phase difference between the working emf e_2 and exciting emf e_3 would also become smaller than 90 time-deg., as shown in Fig. 32. In this figure the vector e_3 has been displaced from the position it occupied in Fig. 31 by a time-angle β equal to the space-angle by which the line joining points 45 and 46 of the armature 41 of Fig. 30 differs from the line joining points 47 and 48 thereof. Knowing the location of the vectors representing the working emf e_2 and the exciting emf e_3, and knowing that the back emf e_1 must differ in time-phase by 90 deg. from e_3, the resultant emf R, which determines the phase and magnitude of the current in the armature circuit, can immediately be ascertained by constructing a parallelogram two sides of which are made equal to the vector e_2 and two other sides of which are made equal to the vector e_1, as shown in Fig. 32. It is at once seen that this resultant now leads the working emf e_2 by a very large angle. The phase position of the current through the armature circuit is determined by the fact that this current always lags behind the resultant emf in that circuit by the same small angle α. This is also shown in Fig. 32, which figure clearly indicates that owing to the small change made in the phase of the exciting emf the current taken by the armature of the motor now leads the working emf



FIGS. 31 AND 32—TIME-PHASE RELATION BETWEEN WORKING EMF AND ARMATURE CURRENT AS AFFECTED BY A CHANGE IN THE PHASE OF THE EXCITING EMF

e_2 by a very large angle θ, instead of lagging behind this emf by a small angle θ equal to α, as was the case under the conditions considered in connection with Fig. 31. Had the exciting winding 33 of the motor shown in Fig. 30 been connected to the points 43 and 44 instead of the points 45 and 46, then the resultant R would have lagged behind the working emf instead of leading it, and the lag of the cur-

rent *I* shown in Fig. 31 would have been increased instead of being converted into a lead, as was proved in connection with Fig. 32. These remarks clearly show that it is possible to vary the time-phase relation between the working emf impressed on the armature of an alternating-current motor and the current taken by it to almost any desired extent, simply by altering the time-phase of the exciting emf relatively to the phase of the working emf, or, in other words, by altering the time-phase of the exciting flux relatively to the phase of the working emf.

The conclusions reached may be summarized by stating:

(1) That any practical alternating-current motor in which there is a time-phase difference of 90 deg. between the working and the exciting emf will operate with a "lagging" power-factor.

(2) That the power-factor of any alternating-current motor can be improved by causing the exciting emf either to lead the working emf by less than 90 time-deg. or to lag behind the latter by more than 90 deg.

(3) That the power-factor of any alternating-current motor can be diminished by causing the exciting emf to lead the working emf by more than 90 time-deg. or to lag behind it by less than 90 deg.

The same thing can also be expressed by saying:

(4) That any practical alternating-current motor in which the phase of the exciting flux either coincides with the phase of the working emf or differs therefrom by 180 time-deg. will operate with a "lagging" power-factor.

(5) That the power-factor of any alternating-current motor can be improved by causing the exciting flux to lag a little behind the working emf or to lead it by somewhat less than 180 deg.

(6) That the power-factor of any alternating-current motor can be reduced by causing the exciting flux to lead the working emf by a small angle or to lag behind it by a little less than 180 deg.

(7) Generally speaking, one can say that the power-factor in any alternating-current motor can be controlled, within the widest limits, by changing the phase of the exciting flux relatively to the phase of the working emf.

A further discussion of the subject of phase compensation will be presented by Mr. Val. A. Fynn in a subsequent issue.

A. I. E. E. Papers and Discussions

In the following columns are to be found papers and discussions on the subjects of high-tension transmission, corona and synchronous motors which were omitted from the report of the Cooperstown convention of the A. I. E. E. in the issue of the *Electrical World* of July 5

Constant-Voltage Transmission

From experience already obtained with the constant-voltage method of transmission-line operation in the case of several small lines, a number of the advantages of this practice were pointed out in a paper by Mr. H. B. Dwight. In the case of the constant-voltage scheme not only is the voltage regulated as usual from the generator end, but at the receiving end synchronous motors or condensers are also operated to control the received pressure by adjustment of the power-factor. By proper field excitation these machines may be made to offset the reactance drop of the line, which is greatest at low power-factors. The drop can thus be changed to a rise in voltage if the reactive component is leading instead of lagging, and this may even be sufficient to overcome the drop due to resistance also. While the synchronous-motor capacity required is from one-half to two-thirds the generator rating installed, adding considerably to the investment, the result is found not only in improved service but also in increased line capacity. The latter carrying capacity can be increased to twice or three times its ordinary value by such synchronous control, so that the saving in construction costs may more than offset the investment in additional machinery that would be necessitated.

Summing up, the author stated that the following advantages accrue from constant-voltage operation: (1) Better service—no variation in voltage. (2) Better protection,

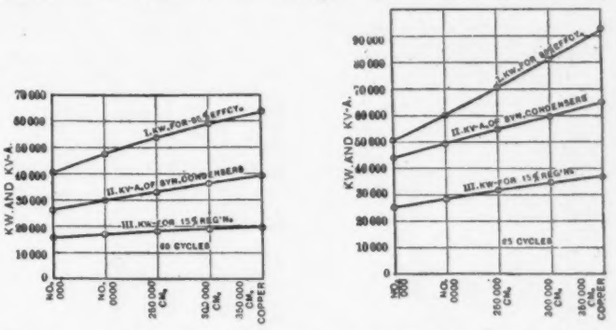

KW AND KV-A.
I. KW FOR 95% EFFCY.
II. KV-A. OF SYN. CONDENSERS
III. KW FOR 15% REG'N.
60 CYCLES
KW AND KV-A.
I. KW FOR 95% EFFCY.
II. KV-A. OF SYN. CONDENSERS
III. KW FOR 15% REG'N.
25 CYCLES

FIG. 1—CONDENSERS REQUIRED AND CARRYING CAPACITIES OF CONSTANT AND VARYING VOLTAGE LINES

due to high reactances. (3) Tendency to use 60 cycles. (4) Increased carrying capacity of line. The limit is changed from maximum voltage variation to maximum energy loss. (5) Lower total cost for long lines. The saving in cost is greatest for long lines or large networks, large quantities of power, large conductors, and for 60 cycles. (6) The method is easy to apply to existing lines. The change can be gradual, and no change is necessary in line construction.

The disadvantages were enumerated as follows: (1) Cost of attendance of additional rotating machinery. (2) Higher total cost for short lines. (3) In order to obtain the greatest economy from constant-voltage operation, the losses must be increased and the number of separate lines, which are useful as reserves, must be reduced. (4) Tendency of synchronous machinery to drop out of step, and delay in putting load on the line again after shut-down.

Taking estimates from a 200-mile, 33,000-kw, 116,000-

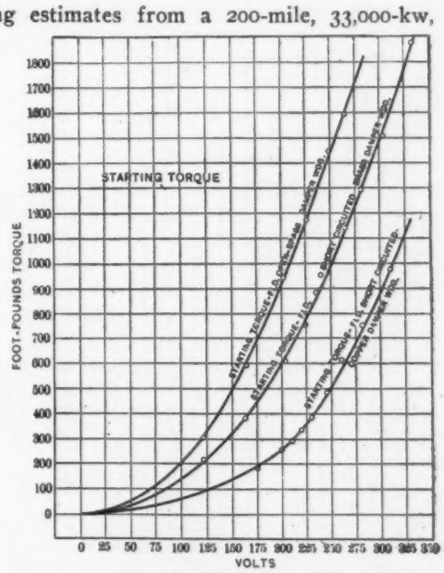


FIG. 2—COMPARATIVE STARTING TORQUE

volt system, the author showed a saving of $1,000,000 out of an investment of $2,200,000 required for the usual varying-voltage scheme of operation. Similarly, for a 100-mile, 54,000-kw, 113,000-volt line, the constant-voltage scheme would involve only $997,000 investment—a saving of $263,000 of the $1,260,000 which would be needed for the varying-voltage system.

Starting of Synchronous Motors

A large number of oscillograms made under his direction were shown in a paper by Mr. F. D. Newbury to indicate the physical phenomena taking place in the windings of synchronous motors during the starting operation under a wide range of conditions. The machines tested were similar 2400-volt, three-phase units, one of 200-kva and the other of 150-kva rating. Both were provided with copper damping windings of low resistance, serving as dampers during synchronous operation and assisting in starting at light initial torques.

From the oscillograms and curves presented in the paper the following conclusions were drawn:

The effect of the closed field circuit on initial torque is negligible if damper windings of good design are used. With open field circuit during starting dangerous voltages are induced in the field winding. For all ordinary applications, at least, motors should be started with closed field circuit. Successively larger loads can be pulled into synchronism if synchronism is attained on the starting voltage without excitation, on the starting voltage with excitation, and on line voltage with excitation. For moderate loads the minimum starting current is obtained by considerably over-exciting the motor before changing to line voltage. For large loads, during starting and synchronizing, minimum starting current is obtained by under-exciting the motor before changing to line voltage. Further reduction in starting current is obtained by the use of reactance between the change from starting to line voltage, in which case excitation is delayed until the motor is near synchronism.

Industrial Uses of Synchronous Motors

In a discussion of the industrial use of synchronous motors by central stations, Mr. John C. Parker pointed out

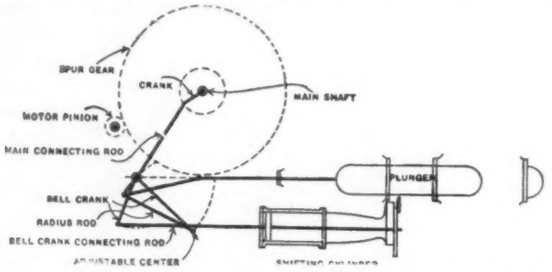


FIG. 3—LINE DIAGRAM OF 6,000,000-GAL. VARIABLE-STROKE PUMP

that the customer naturally takes little technical interest in such equipment since it is more expensive, less substantial, harder to operate and less adapted to small units. Its principal application is in large group drives not subject to frequent starting or to starting under load. The customer's motive for making such an installation must be found either in a rate schedule favorable to unity or leading-power-factor conditions, the sharing of the initial expense by the central station, or the offer of a special rate lower than that for induction-motor operation in cases where synchronous operation will improve distributing conditions.

Where the metered demand is based on the kilovolt-amperes rather than the kilowatts, the customer will have a material interest in keeping the power-factor as near to unity as possible. In the case of long-distance transmissions the incentive thus supplied may amount to from 10 to 30 per cent of the total cost of service. Automatic potential regulators should be inserted in the line to hold the voltage constant at distant points in the system, either with or without inductance in series with the line. Such control combines the two functions of load-carrying and regulation in a single piece of apparatus. It is recommended for use with series reactance in cases where the synchronous quadrature demand exceeds the lagging quadrature demand. The line may also be broken up into segments, with inductances inserted between the section points so determined with relation to the synchronous-motor taps that the potentials at adjacent inductances will be equally high above and below the voltage for which the regulator is set. In this way will be obtained the flattest voltage curve between inductances and improved regulation over the whole length of line.

By adaptation of the driven mechanism it is often possible to adjust the load to the motor-starting conditions as well as to variable output at constant driving speeds. A reciprocating pump, for example, may have its linkage so controlled by hydraulic means that the piston stroke can be varied between full-travel and zero, bringing the no-load torque at starting well within the range of the motor. Adjustable clearance spaces can also be employed with pumps handling gases.

Discussion

The three papers by Messrs. H. B. Dwight, F. D. Newbury and John C. Parker were discussed together, although the Dwight paper was presented under the auspices of the high-tension committee and the other two under the industrial-power committee.

In opening the discussion Mr. F. D. Newbury told of one instance in which a sychronous condenser was used in connection with a long high-tension transmission line. He also said that a frequency of 60 cycles is becoming more general in railway work, since the 500-kw, 600-volt, 60-cycle synchronous converter is now standard. This machine, the speaker said, is stable in operation and holds in step satisfactorily at no load and small excitation.

Mr. R. B. Williamson of Milwaukee, Wis., said that Mr. Newbury's paper cleared up a number of doubtful matters connected with synchronous-motor operation and that the very complete oscillograms given in the paper left comparatively little room for discussion. It was worthy of note, he remarked, that the rotor of the motor tested was laminated instead of solid. Troubles in some of the early motors, made up from standard alternator parts, were due, he said, to solid rotors, while now they are built on the squirrel-cage principle. He then described some tests on a 125-kw turbo-alternator with a round rotor operated as a synchronous motor. At half-voltage it was possible to exert quarter-load torque with one and a quarter times full-load current. On full voltage he thought it would have been possible to exert full-load torque.

Mr. H. M. Hobart stated that there are several available means for improving synchronous motor performance which only await application. The design of such motors should be, he thought, in the hands of induction-motor designers. High starting-torque characteristics are obtained in an induction motor at the expense of considerable heating and slip at full speed, whereas the latter objections are eliminated in the synchronous motor when it falls into step at synchronism. In fact, said the speaker, the synchronous motor can be designed for better starting torque than an induction motor, and it can be made in small sizes.

Mr. Hobart remarked that economic limitations are forcing consideration of the very highest available transmission voltages, which make the paper of most timely importance. The conclusions stated, he thought, were very forcefully expressed.

Captain Lee Hagood, Schenectady, N. Y., commented on the simplicity of the formulas given by Mr. Dwight, and exhibited a number of lantern slides showing the results obtained by the use of synchronous condensers in a transmission system which had been planned under his direction. The real starting point in transmission-line design is the decision as to the use of synchronous condensers.

Mr. W. J Foster commented upon what he termed the chief undesirable characteristic of the self-starting synchronous motor, namely, the high value of the induced emf across the field terminals during starting. In the 125-

volt machine field, said he, there is no great difficulty from this cause, but the 250-volt machine presents a more serious problem. Short-circuiting the field coils during starting removes the first difficulty but impairs the starting torque; it is also possible to help the situation by waiting to short-circuit the field coils until the machine reaches two-thirds synchronous speed, but the most satisfactory plan of all is to arrange the field circuit for low voltage. In response to questions from Mr. A. H. Kruesi regarding the machine tested, the author replied that it had twelve slots and six bars per pole and a 0.25-in. air-gap.

Mr. W. E. Funk, of Philadelphia, Pa., said that for economic reasons he recommended keeping the station power-factor at unity, instead of aiming for constant-voltage transmission, as the author had done.

Mr. H. W. Peck said that old synchronous apparatus in central stations might be worth more if operated as synchronous condensers than they would bring as scrap, and he planned to commence such an investigation at once upon his return home.

Mr. B. McCollum, of Washington, D. C., criticised Mr. Dwight's conclusions in the respect that savings in transmission cost arising from constant-voltage transmission had not been offset by the resultant increase in line losses and the attendant increase in cost of operation. The major improvement from this system of operation, said the speaker, is in better regulation and steadier operating conditions.

Mr. Dwight replied that the line energy loss is not a serious matter and would not affect the conclusions stated in his paper. The maximum, or peak-load, loss, he pointed out, is not the ruling consideration, but the average twenty-four hour loss. For almost any case it will pay to consider the use of synchronous condensers. He then gave some specific figures showing the increase in transmission-line rating secured by this method of operation. In reference to synchronous condensers for city distribution systems he gave it as his opinion that their use is questionable because the power-factor fluctuates, the wattless current sometimes being lagging and at other times leading.

Replying to a question from Mr. P. M. Lincoln in regard to types of rotor, Mr. Newbury said that the damper winding (squirrel-cage) of least resistance will give the largest pull-in torque but the smallest starting torque. The magnetizing current in an induction motor is much less than that in the synchronous-type machine, which fact is an element in favor of the squirrel-cage starting device. He also said that a salient-pole rotor is preferable to the round type.

Mr. M. O. Dellplain, Syracuse, N. Y., the next speaker, voiced his belief that synchronous motors are not yet as reliable as induction motors for central-station service, except in the relatively few cases of customers who have large installations. There is also lacking, he said, an economical polyphase meter to measure the customers' kva demand. Mr. H. W. Peck took up the discussion at this point and said that it is often possible to use synchronous motors, and that the cost of the necessary meters is not prohibitive in a large installation.

Dr. C. P. Steinmetz characterized the papers dealing with synchronous motors as very important, giving new and useful information. The modern synchronous motor, he said, is very well able to start from rest with considerable load and carry it successfully up to speed. Sometimes the synchronous motor will give more starting torque, sometimes less, than the induction motor. But the induction type cannot at the same time possess the best starting properties and the best running properties, while the synchronous type is handicapped by no such limitation. The synchronous type, he said, is distinguished by three typical differences; first, it does not have uniform magnetic reluctance in all directions, which is a characteristic of the induction type; secondly, it has a longer air-gap, which gives it an advantage in starting, and, thirdly, it has higher secondary resistance and greater starting torque.

The oscillograms given in Mr. Newbury's paper show many things, said Dr. Steinmetz, which were not brought out. The fluctuations in current, for example, correspond in the fluctuations of reluctance from pole to pole. It is also possible to construct the speed-time curve of acceleration and the speed-torque curve. That is to say, all the characteristic curves of the motion can be obtained from the oscillograms. The characteristic drops in torque at one-fourth, one-half and three-quarters of synchronous speed are thus shown. The large synchronous motor, he said, is one of the most important elements in an electrical system, and instead of impairing the power-factor improves it.

Mr. W. L. Merrill brought out the point that the comparisons made were based on the squirrel-cage type of induction motor which is well known to be inferior in starting characteristics to the wound-rotor, slip-ring type.

Dr. Steinmetz contended that the starting characteristics of a synchronous motor with squirrel-cage winding are naturally compared with the same type of induction motor because they are similar, and, moreover, most induction motors are of the squirrel-cage type.

Mr. F. D. Newbury, continuing the discussion, pointed out that the torque characteristics needed at starting vary with the conditions. For example, motor-generator sets require the maximum torque at starting, whereas in the case of motor-driven fans, air-compressors, centrifugal pumps, etc., the maximum torque occurs at full speed. The point was also made that it is difficult to obtain high torque at pull-in with motors of large output and slow speed; a standard figure has been 15 per cent.

Mr. R. B. Williamson mentioned the difficulty of determining the starting torque required for many kinds of machinery and spoke of a 2400-hp synchronous motor connected to a pulp grinder, requiring only 1200 hp under normal running conditions, although the starting conditions were severe.

Dr. Steinmetz stated that the matter of pull-in torque needs more study. A sudden jump or acceleration of speed from a definite slip to zero slip is required, and getting safely past this point is often more important than the dead drag or normal load torque.

Speaking of the round type versus the salient-pole type of rotor, Mr. F. D. Newbury said that the choice depends mainly on the cost, the salient-pole type being the cheaper.

Mr. W. J. Foster corroborated Mr. Newbury's view of the last problem, and recommended a broader polar arc, equal to from 80 to 85 per cent instead of the usual 60 to 65 per cent of the pitch.

Mr. H. M. Hobart stated that the torque of the round type of rotor increases all the way up to synchronism, but on this point Mr. Foster took issue and said that the torque drops at pull-in.

Mr. W. L. Merrill added that large induction motors are of the form-wound type and that if synchronous motors can be designed with equally good characteristics they will become very useful in central-station service.

Touching again upon the two types of rotor, Dr. Steinmetz claimed that the definite-pole type is inferior, with respect to starting torque, to the uniform reluctance type, but the reverse is true at pull-in. What is needed is a high-resistance squirrel-cage for starting and a low-resistance cage for pulling in. As between the two types of rotor there is no great difference and the choice, he said, is one depending mainly on economic considerations.

SPECIFICATIONS FOR TESTING HIGH-VOLTAGE INSULATORS

In an effort to draw up a "skeleton" or model specification form for the testing of insulators the high-tension transmission committee secured two tentative specifications, one by Mr. F. W. Peek, Jr., written from the viewpoint of the expert tester and scientist, and the other by Mr. J. A.

Sanford, Jr., prepared from the standpoint of the manufacturer. From these two the chairman of the committee, Mr. Percy H. Thomas, prepared a single specification embodying what are believed to be the best features of the preceding forms as well as suggestions obtained from members of the high-tension committee and others. Among the topics covered in the specifications are: Dielectric surface, cement, fragility, design, factory tests, arc-over tests, corona, voltage balance, uniformity, impulse tests, measurements, mechanical stress, mechanical inspection, protection of metal parts, galvanizing, glazing, absorption, crating, rain tests, dew tests, breakdown, corrosion, wave-form of test voltage, capacity of test apparatus, frequency, etc.

Discussion

In discussing the paper Mr. Sanford remarked that nearly every high-tension line in the country will show visible corona in perfect darkness. He thought that Mr. Peek's requirement of no sign of corona at one and three-tenths times line voltage too severe, as most insulators will show some visible corona in a perfectly dark roof at less than line voltage.

Mr. L. C. Nicholson read a communication describing tests on about 200 insulator units, showing that there is a connection between the dielectric strength or puncture voltage and the mechanical stress or load imposed, the inference being that the dielectric strength of a unit diminishes under mechanical stress. These results Mr. P. H. Thomas characterized as most important and urged the need of exhaustive investigation without delay. While it may turn out that the necessity of testing insulators electrically while subjected, prior thereto or simultaneously, to mechanical stress will be burdensome upon the manufacturer, such a course is worth while if the results seem to justify it. The point was also raised whether the Institute should formally adopt or approve an insulator specification, and whether instead it should not issue rules to serve as a guide to the writing of specifications.

A question was raised by Mr. H. W. Crozier, San Francisco, Cal., as to what had become of the proposition once advanced that every unit in the string should withstand the full line voltage, and also whether it would be necessary to stress every insulator mechanically in the acceptance test.

Mr. J. B. Taylor read a communication from one of the Japanese engineers present, describing the results of puncture tests in air and oil, giving values for the latter equal to only from 80 to 90 per cent of the former, for insulators of Japanese make. This was explained by Mr. F. W. Peek, Jr., as being probably due to electrostatic field concentration in the oil, but domestic insulators do not act in that manner. It was pointed out by Mr. P. H. Thomas that it is undesirable to have two methods of tests which could not be distinguished by their results.

Mr. L. C. Nicholson drew attention to the desirability of keeping the mechanical stresses as low as may be, using two or more strings in parallel if the expense is not prohibitive. There are other things about insulators which electrical engineers ought to know but do not, such as the effect of mechanical loads in actual service, the proper material for cement or a substitute for it, and the art of ceramics. Quoting from Mr. A. O. Austin's results, he said that temperature changes alone might induce porcelain stresses as high as 400 lb. per sq. in., while from his own tests 1000 lb. per sq. in. might cause electrical failure. There is also the fundamental question whether the type of design is correct. When dry a string will flash over as an entire unit, but when wet will flash from unit to unit, which raises considerable doubt as to the design. The suggested specification, he thought, was good as far as it went, but incomplete. Engineers, he declared, should go into the whole problem broadly and master the art of manufacture, giving special attention to the mixing room.

Mr. C. O. Mailloux objected to the last point and said that just as "the shoemaker should stick to his last," so should the electrical engineer keep out of the porcelain works and confine himself to demands for final results. Calling attention to the great variation in the resistivity of water with the impurities present, Mr. P. M. Lincoln recommended that rain tests should be made with distillate, since natural precipitation itself is pure. Also, he said, the test should be made with the pin grounded, in order to reproduce service conditions.

Mr. H. T. Wreaks, of New York City, advised against going into the mixing room, illustrating his point with an example of the difficulties certain engineers plunged themselves into by attempting to specify the composition of certain rubber compounds used for wire insulation. In his experience he also found that the matter of crating insulators for shipment is very important from the practical point of view, as damage in transit may impair the insulator efficiency.

Prof. E. E. F. Creighton, speaking of vitrification of porcelain, said that it seems impossible to determine what it really is or to define it. But if the manufacturers refuse to make the necessary researches to disclose its true nature, then engineers must do so. There are other things to consider, said he, besides the water absorption test. Temperature and time both play exceedingly important parts in vitrification. In his experiments with clays, using an electric furnace, it was found very convenient to measure temperature by raising an incandescent lamp filament to equal incandescence with the clay mass, by sighting the former against the latter. The error in this method was within about 10 deg. in 1400 deg. Upon repeated applications of the temperature the vitrification increases, but less rapidly, and finally becomes constant, and at the same time the product becomes brittle. Insulators, the speaker said, are really used only at very high frequencies, as with lightning or arcing grounds. The phenomenon of corona in the air acts as a relief or safety valve under excessive electrical pressure. Finally, he thought, porcelain will be treated like any other insulation and never stressed above a certain percentage of its ultimate strength.

Mr. R. D. Mershon said that questions connected with the design tests should be disposed of first, if possible, leaving only routine tests to be taken up when the manufacturer is ready to deliver the product. It is not advisable, in his opinion, to go into ceramics, but he suggested some joint Institute meetings with ceramic engineers. Porcelain, said the speaker, is more unreliable than other electrical material, and information concerning it is vague, indefinite and conflicting. For illustration, a piece of porcelain which sustained a stress of 2200 lb. per sq. in. fractured when allowed to fall to the floor. An oil puncture test is desirable, but the trouble is to determine how it ought to be carried out; it is also very desirable that the puncture test when applied should give uniform results, or, in other words, that the product should be as homogeneous as possible. As to the rain test, the speaker said a rate of 1 in. rainfall in five minutes is greater than ever recorded. In order to insure a factor of safety under such service conditions it is better to raise the test voltage than to increase the precipitation so much above the maximum natural rate. It is also better to incline the axis of the insulator and use a vertical spray than the reverse. He pointed out that the specifications say nothing about handling the insulator after the cementing is done, although it is very important that the cement should not be permitted to freeze. In practice he has observed no difference whether the flash-over starts over the string as a whole, or from unit to unit, and in any case the breakage of units results from the heat of the "power" arc.

Continuing the discussion, Mr. E. M. Hewlett, of Schenectady, N. Y., said that the general design is the first point to be settled. The power arc will always throw itself clear

of the units regardless of whether the string flashes over initially as a complete unit or from disk to disk. The inspectors at the factory, he said, enjoy the "fireworks" and hence raise the rate of precipitation until they occur. An insulator hanging at an angle is under the advantage that the drip generally falls clear of the units beneath; the wind is also a factor. A moisture-absorption test of 0.1 per cent the speaker regarded as rather severe and likely to raise the cost. It is very important to call for uniform material. Ceramic workers, said he, can make any kind of porcelain wanted, but the handling of the product during the process is everything. Different kinds of clay do not serve equally well for all designs of insulators, but some varieties serve better under given requirements than do others.

Mr. H. W. Crozier, San Francisco, Cal., recommended the tongue or taste test as a quick means of discovering porcelain having absorption defects, while defective vitrification, he said, can be detected on sight by an experienced inspector. He also recommended soaking the porcelain in water and submitting it afterward to an electrical test, as a means of detecting absorption. Mr. P. W. Sothman, New York, pointed out that the same insulator will not give equal service everywhere. He was opposed to attempting to devise a perfectly general specification covering every detail, but advised a separate specification for each job and a steadfast adherence to it in each case. The speaker opposed any plan to tell manufacturers how insulators should be made, and advised limiting the specification wholly to results. He opposed Mr. P. M. Lincoln's opinion as to the use of distilled water in the spray test, and said that in general the test should reproduce as far as possible the actual conditions imposed by nature in the locality where the insulators will be used. The proposal to work out a detailed specification met with his opposition, and he preferred instead a set of notes or rules for general guidance in writing specifications. Prof. C. F. Scott, New Haven, Conn., stated that in his opinion the proper order of attacking the question was as follows: Designing, engineering, and commercial testing.

The Electric Strength of Air

In the fourth paper of the series by Messrs. J. B. Whitehead and T. T. Fitch the study of the effect of pressure on corona formation was extended to include wider ranges of pressure and diameters of conductor than were attempted in the earlier investigations. The results reported by the authors show the close relation of the observed phenomena with the formula by Mr. F. W. Peek. A 10-kw, 100,000-volt transformer supplied the energy. For the pressure measurements a 20-cm iron tube, 90 cm in length, was used, the ends being fitted with fiber insulating caps 18 cm long. A gold-leaf electroscope permitted detection of the beginning of corona.

Observations made with carbon dioxide indicate that the critical corona intensity is independent of the absolute density of the gas but depends on the number and spacing of the molecules in accordance with the theory of secondary ionization. The critical corona-forming electric intensity in air has been determined over the range of pressure from 5 cm to 108 cm of mercury column for nine sizes of round conductor, including diameters from 0.23 cm to 0.95 cm. The ionization theory fails to show why the critical intensity varies with conductor diameter and why the intensity with respect to pressure changes does not follow a linear law. Corona begins and ends at approximately the same voltage on the emf wave, indicating that the rate of ionic recombination is very great.

Precipitation and Positive and Negative Corona

In experiments reported by Mr. W. W. Strong, high-voltage alternating current taken from the secondary of a transformer was rectified by a Lemp synchronous commutator. The coronas produced by the resulting rectified current were then used to remove suspended matter from gases. Wires extending through the center of grounded 5-in. cylinders formed the discharge electrodes.

From the results obtained for the positive and negative coronas it is seen that the ionization of a gas affects the two coronas differently. Owing to experimental difficulties it could not be shown, as hoped, that the effects of the alternating-current corona were the additive effects of the two direct-current coronas, positive and negative. For given differences of potential the negative corona loss is less than the positive corona loss. In still air the sparking potential is approximately the same for both coronas, although the presence of even a small air current permits the potential difference to be raised considerably. Since the negative corona is much more uniformly distributed about the active electrode, and on account of its greater

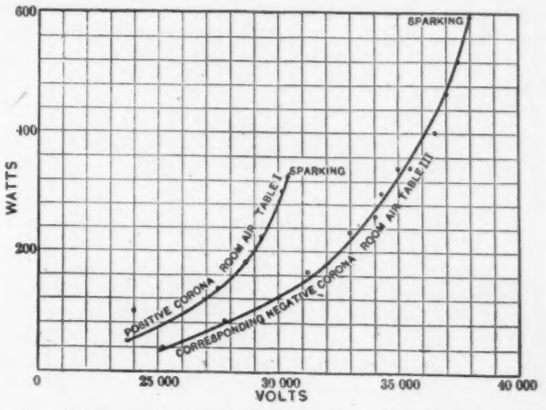


FIG. 4—WATTS LOSS OF POSITIVE AND NEGATIVE ELECTRODE

stability as regards sparking, the negative discharge is the most suitable for electric precipitation. The chamber described has a capacity for cleaning 800 cu. ft. of gas per minute and consumes about 300 watts under the best conditions of negative corona operation.

The positive corona loss in both room air and ionized furnace gas is about the same. Increasing the air velocity increases the sparking potential of a negative corona in ordinary air. The corona watt loss is also considerably greater in hot ionized gas than in air. The positive corona tends to go over to an oscillatory spark while the negative corona is more easily changed into an arc form of discharge. Presence of suspended matter in gases does not affect the corona currents greatly, but in hot gases it increases the sparking potential, probably owing to the disappearance of the smaller ions. The presence of suspended matter in ordinary air decreases the sparking potential.

Corona and the Dielectric Strength of Air

The greater dielectric strength of air at the surface of small conductors was long attributed to a condensed film at the conductor surface. But the breakdown gradient, as expressed by Mr. F. W. Peek, Jr., in a third Institute paper on the subject, suggesting a theory of rupture, is as follows:

$$g_v = g_o\left(1 + \frac{k}{\sqrt{r}}\right)$$

This means that at breakdown the gradient is always constant and equal to g_o, at $k\sqrt{r}$ cm from the conductor surface, independent of the size of the conductor. The explanation seems to be that energy is necessary to start rupture and that, therefore, rupture cannot start at the surface, but only after the surface gradient has been increased to g_v, in order to store the rupturing energy between the conductor surface and $k\sqrt{r}$ cm away in air, where the gradient is g_o.

According to the above theory, if the wires were spaced very close together, g_v would increase in value in order to

store sufficient energy to start rupture in the limited distance.

It has been found that the gradient begins to increase at a spacing of $2\,k\sqrt{r}$ cm and, within the limits of the tests, g_v values as high as 200 kv per cm or 500 kv per inch have been reached. Spheres were used in these tests as it is impracticable to adjust cylinders at small spacings. The electron theory may also be nicely applied to the above, when the distance $k\sqrt{r}$ may be thought of as the "accelerating distance."

Oscillographic Study of Corona

Mr. Edward Bennett presented a paper in which was described a method of obtaining oscillograms of the charging current of a 10-ft. length of wire, representing current strengths of the order of 0.005 amp. By passing this small current through the primary of a 1/100-milliamp current transformer a secondary current was obtained in the latter circuit closed through the oscillograph vibrator. A large number of oscillograms illustrate the paper, showing the wave-form of the charging current with the wire surrounded by corona, etc. For obtaining these records the air pressure surrounding the wire was reduced to 0.13 cm

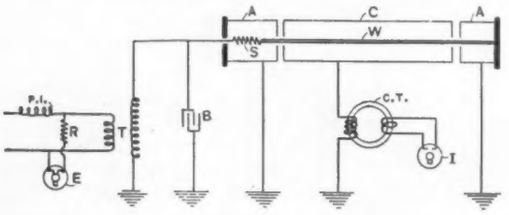


FIG. 5—CONNECTIONS FOR OSCILLOGRAMS OF CHARGING CURRENT OF A WIRE

of mercury. Among the effects illustrated may be pointed out the marked asymmetry in the current after corona begins, the relation between watts loss and impressed voltage, the beginning of the corona after switching, variation in results at high and low air pressures, distortion of wave-form due to ionization, quadratic relation between power expended in corona and impressed voltage, etc. A curve is also plotted showing the relation between the air pressure and the voltage required to cause the distortion to appear in the current wave-form.

Discussion

Mr. P. M. Lincoln remarked that corona loss varies as the frequency, and apparently while it requires energy to create it, a less amount is required to maintain it. This, he thought, leads to the conclusion that there could be no corona with continuous emfs and asked the authors to explain.

Prof. C. F. Scott recounted the history of experimental researches on corona, commencing with the work of Mershon and Ryan some fifteen years ago. He also commended the authors very highly for the latest contributions to the subject.

Mr. L. T. Robinson, Schenectady, N. Y., said that the details of these researches are becoming constantly of more interest and importance. In particular, he was interested in the possibilities of measuring high voltages by means of corona, since its occurrence is noted at a point which in each case is defined rather sharply. He asked the authors to discuss this point especially. The speaker also commended Professor Bennett's careful analysis of his results. Since only 0.0025 watt is required to operate the oscillograph, said Mr. Robinson, transformers for multiplying the current can be used to good advantage. Of course, this amount of power, although small, is considerably larger than the amount required, for example, to operate some types of Weston instruments, which need something on the order of 0.0001 watt.

Prof. A. E. Flowers, of Columbus, Ohio, speaking of precipitation by corona, said the subject has a considerable history in the realm of physics. Fleming and Wilson in England have studied it and Carpenter has investigated it in cement mills in the West. The speaker touched upon the work of Milner in England on high-frequency corona, carrying the frequency as high as 200,000,000 cycles per second. He illustrated Milner's results by drawing a number of different curves on the blackboard showing wave-shapes.

Mr. J. B. Taylor remarked briefly upon a differential method of measuring corona current which he suggested several years ago and which Professor Bennett had employed in his tests.

Prof. V. Karapetoff, of Ithaca N. Y., asked why in Dr. Whitehead's paper the dielectric strength of air at rupture should be 50 kv per cm instead of 30 kv or the usually accepted value.

In reply to a question by Mr. P. M. Lincoln, Prof. A. E. Flowers said that Watson in England had investigated corona phenomena with continuous emfs up to nearly 100 kv. Prof. V. Karapetoff remarked that the corona energy-loss curve is a parabola crossing the Y ordinate above the origin, thus proving that there is some loss at zero frequency or with continuous emfs.

Dr. J. B. Whitehead then closed the discussion on his paper, remarking upon the value of the ionization theory of conduction in gases. It is not rational, he said, that an increased gas temperature should reduce the sparking potential, and he attributed such a result to the presence of solid particles. The same explanation may apply to the effect of air in motion. He took occasion again to question the soundness of the energy-zone theory advanced by Mr. Peek. Speaking of Professor Bennett's work, which he praised highly, he emphasized the importance of temperature and remarked that the copious ionization referred to is instantaneous. The energy loss is due, he said, to actual breaking down of the molecules and the passage of a conduction current. The discrepancy between the loss curves for parallel cylinders and concentric cylinders is accounted for by the difference between the paths in the two cases. In concentric cylinders the paths are short and straight, while in the case of parallel cylinders the paths deviate and some of the ions fly off so far as not to reach their destination during a half-cycle. Dr. Whitehead told briefly of his work in developing an apparatus to measure high potentials by means of corona, which he hopes soon to perfect and to describe in a communication to the Institute. Replying to Professor Karapetoff's question, he said that the rupture value of 30 kv per cm for air applies only to parallel-plane electrodes.

Mr. W. J. Hammer, New York, called attention to the properties of the surfaces of certain metals and the effect of chemical reagents upon them, with a possible bearing on corona phenomena.

Mr. F. W. Peek, Jr., in closing described the characteristic curve of corona loss, which he said would pass substantially through the origin if extrapolated, but added that in all probability it would take a different form near the origin, at lower frequencies, and cross the Y axis at some definite value corresponding to the corona loss with continuous emfs. But between 25 and 60 cycles he said that his empirical formula for the energy loss, which varies as the frequency, is correct. In conclusion the speaker stated that the ionization theory can hardly be accepted as yet to explain all high-tension phenomena.

Professor Bennett closed very briefly, saying that the string galvanometer, in reference to which Professor Flowers asked a question, could not be used in this work on account of its long period. He also referred to a hollow cylinder enveloping a concentric cone which had been adapted by Professor Ryan for measuring high potentials by means of corona.

Central Station Management

Devoted to Discussion of Administrative Policies, Commercial Methods, and Current Practice Among Successful Utilities

New Showrooms in St. Louis

The Union Electric Light & Power Company opened its new electric appliance showrooms at the headquarters of the company, Twelfth and Locust Streets, St. Louis, on June 25. On the opening day "electric tea" was served, and a discount of 10 per cent was given on all articles purchased. Desk fans, vacuum cleaners, electric flatirons, toasters, coffee percolators, hair curlers and driers, electric grills, teapots and many other appliances are attractively displayed.

Utilizing Fans to Drive Fly Chasers

An attractive and practical application of electric drive is employed in one of the fruit and confectionery stores run by Manusos Brothers of Chicago. The store, which is at the corner of Van Buren and State Streets, has two of its walls covered with plate-glass mirrors. In the summer it is difficult to keep these large mirrors spotless on account of the flies. To eliminate frequent cleaning an endless tape, about 0.75 in. wide, carried horizontally on rollers and supporting vertical strips of ribbon, is kept in motion by belts connected to the pendent-type electric fans already installed in the store. The ribbons are of various colors and are arranged in harmonious combinations. The suspended ribbons, which are spaced about 4 in. apart, traveling in one direction on one side of the movable belt and in the opposite direction on the other side, give a very pleasing effect. There are four 36-in. pendent electric fans in the store, and three of these are belted to pulleys which drive the endless ribbon. This installation required only a slight addition to the fans. A pulley was constructed with the support of the fan as an axis so as to be driven by arms connected to the fan blades.

Increase in Electrical Energy Output at Minneapolis

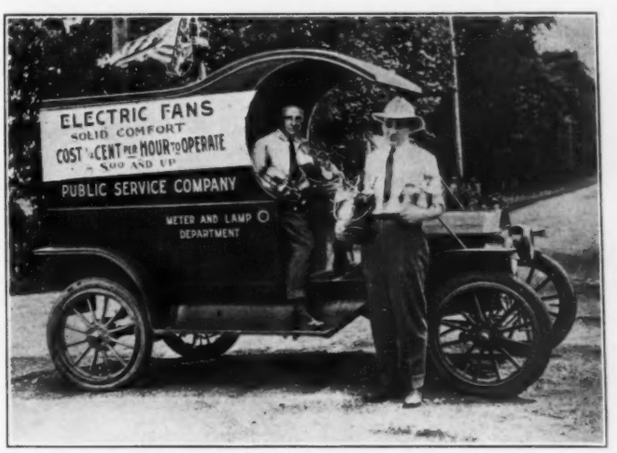
Two contracts recently secured by the Minneapolis General Electric Company indicate the rate at which new business is being secured in the Minnesota city. Figures show that the weekly electrical energy output for 1913 has increased from 35 to 50 per cent over the corresponding period last year. One of the latest contracts to be closed is that for furnishing the L. S. Donaldson Company with electrical energy to the amount of 846 hp. The Donaldson company, which owns the largest department store in Minneapolis, has operated a private plant for several years, making it one of the display features of the store. The contract provides for shutting down the private plant for seven months of the year. During the winter months the Donaldson company plans to continue operating its private plant in connection with furnishing steam for heating purposes.

A contract covering a period of ten years has also been secured by the electric service company with the Minneapolis Malt & Grain Company for furnishing 200 kw at 2300 volts. This contract also provides for shutting down a private plant.

Since the first of the year the actual connected motor load on the electric service company's lines has been increased 3500 hp, although this figure does not include the above-mentioned contracts. During the same period the lighting load has been increased 1503 kw. A large force of men is now engaged in constructing a 12,000-hp hydroelectric station on the Mississippi River at Coon Rapids, 12 miles above Minneapolis. When it is completed the energy developed there will be utilized by the Minneapolis company in handling the rapidly increasing load.

A Fan Campaign at Joliet, Ill.

The Public Service Company of Northern Illinois has been conducting a successful electric-fan sale at Joliet, Ill., with the aid of the decorated delivery wagon illustrated.



DELIVERING ELECTRIC FANS AT JOLIET, ILL.

Surmounting the roof of the vehicle is a large fan arranged to run idly with the wind created by the motion of the car. On the sides of the car body are also signs reading "Electric fans—solid comfort—cost 0.25 cent per hour to operate; $8 and up." During recent hot spells electric fans have been delivered by the wagonload in the vicinity of Joliet. Mr. W. C. Hill is superintendent of the local district for the Public Service Company.

Ten Essential Points in Electric-Truck Specifications

Although the proper selection of electric trucks is an engineering problem, its successful solution depends, more than anything else, upon the furnishing of accurate fundamental data to the manufacturer or his representative regarding service requirements. The following fundamental points were recently quoted as essential in avoiding unsuitable selections of equipment which prove injurious to purchaser and dealer alike:

1. What is the nature of the routes to be covered in the service? Is it all a town service or all a country service, or does it partake of both characters?

2. What is the general character of the streets and roads? Are they comparatively level or are steep hills numerous?

3. What are the distances which each vehicle must cover in a day's round?

4. What is the character of the load to be carried? Is it light but bulky, or heavy in comparison with the bulk?

5. Are the packages to be carried of large size, such as heavy furniture, pianos, safes or the like, or are they small, such as groceries, jewelers' boxes, light dry goods, etc.?

6. Are the goods and packages of such a nature that they must be protected from dust and rain or can they be carried in open wagons or so-called express bodies?

7. Are they of a fragile nature, calling for unusually flexible spring suspension if the load be moved at speed?

8. What quantity of goods will usually be loaded up for each trip? Will the load be carried the full distance or only half the distance? Do the vehicles ordinarily return empty or are they partly loaded?

9. What is the most convenient body construction to admit of easy loading and unloading of the class of goods to be handled?

10. Would it be desirable in the case of heavy goods to enable the power of the motor to be utilized in loading or unloading?

An Illinois Farmer's Motor-Driven Feed Cutter

Among the farm customers of the Public Service Company of Northern Illinois in its Lake County electrified agricultural section, northwest of Chicago, is a dairyman who uses the feed cutter illustrated to prepare stock food for fifty head of cattle. With the aid of this machine he grinds the feed at a cost less than that which the mill charged for the same service, in addition to saving the time and trouble of transporting the raw stuff to the mill.

The 10-in. International grinder used is mounted on a second-floor gallery so that the feed as ground can be dropped directly down to the cattle's troughs. The 10-hp motor which drives the machine is installed on the ground floor of the barn, operating through a countershaft and belts. For two feedings daily for fifty cattle the outfit need be operated only half an hour daily. Although the farm is several miles from the town limits, the rate earned is about 7 cents per kw-hr., and the customer's bill averages $14 per month. This is less than the cost of the mill service alone, and the farmer is in addition saved the labor and time of hitching up a team, loading his wagon, driving several miles to the grist mill, waiting his turn and returning with the ground supply. As all this had to be done

MOTOR-DRIVEN FEED CUTTER

during daylight hours, valuable time was taken from other farm duties.

According to the dairyman's own statement, he can now grind a whole day's feed in the time formerly required to hitch up and load his wagon. The grinding can be done, too, after other chores about the place are completed, and it is usually not started until the evening milking is done. The machine will grind twelve bushels in twenty minutes. Single-phase 4400-volt energy is furnished to this customer from an extension to the nearby town distribution system. The schedule employed begins with a rate of 9 cents per kw-hr. maximum, but in the quantities in which service is here used an average rate of 7 cents per kw-hr. is obtained.

Electric Ironing in Shirt-Waist Factory

The accompanying illustration shows a portion of the ironing section of the shirt-waist factory of Hugo Du Brock & Company, of Chicago. Electric flatirons are used,

USING ELECTRIC IRONS IN SHIRT-WAIST FACTORY

pilot lamps indicating which irons are in circuit. These lamps are placed in the iron boxes shown to the left of the center line of operators. Electricity supplied by the Commonwealth Edison Company is used for lamps, motor operation and industrial heating in this well-arranged factory. Sewing machines and cloth cutters are driven electrically.

In the pressing department 9-lb. irons are used. The distribution board has a capacity for six electric irons on each side. Each iron is always at the right temperature for quick and effective work and rests on an automatic regulating stand when not being used. If an iron is to be idle for some time, it is switched off altogether by hand. but otherwise the automatic current-regulating stand is very useful, as it reduces the flow of electricity when the iron is placed upon it, preventing undue heating and waste of energy.

Metered Versus Flat-Rate Steam-Heating Service

The advantages of metered steam-heating service over flat-rate schedules of charging were pointed out in the report of the meter committee of the National District Heating Association at the latter's convention, which was held at Indianapolis.

Flat rates are, for instance, inequitable among customers. In one Illinois city the steam used per square foot of flat-rate radiation ranged from 150 lb. to 3000 lb. per season. Flat rates also make customers extravagant, causing wastes which are a burden on the whole system. Where the company installs temperature-control devices the inspection and maintenance necessary for these will largely offset the cost of maintaining and inspecting meters.

The accompanying table shows the comparative steam consumption and income for the seasons of 1910-11 and 1911-12 for a large heating company. Up to and including the season of 1910-11 the buildings in this table were on a flat rate. These flat rates were based on the consumer's

figures as to what it would cost him for heating. There were, all told, fourteen customers enjoying a flat rate. During the summer of 1911 the company "signed up" thirteen of these customers on a meter rate, losing one customer. These were installed, 240 out of 260 customers being thus equipped. For the next season the income from the heating business increased from a flat-rate business of $17,500 to $23,000 under metered conditions, a gain of $5,500. Despite the

COMPARATIVE STEAM CONSUMPTION AND INCOME

Nature of Building	Radiation, Square Feet	Season 1910-11		Season 1911-12		Per Cent Difference	
		1000 Lb.	Income	1000 Lb.	Income	Steam	Income
Office building	6,738	3,189	$1,200.00	3,552	$1,470.40	+11	+ 22
Bank	950	673	195.90	720	374.75	+ 7	+ 91
Fraternal lodge	4,085	797	358.65	726	376.80	— 9	+ 5
Stores and offices	1,212	755	175.00	877	448.05	+16	+156
Office building	6,421	2,863	670.00	3,566	1,387.40	+24	+100
Stores and apartments	7,006	2,596	960.00	3,405	1,361.30	+31	+ 41
Stores and apartments*	2,950	2,651	425.00	1,470	689.05	—45	+ 61
Hotel†	2,748	3,236	650.00	3,330	1,335.25	+ 3	+105
Stores and manufacturing	18,000	13,925	3,000.00	13,231	4,034.60	— 5	+ 34
Department store	1,908	1,465	450.00	14,498	686.30	+ 3	+ 52
Office building†	25,000	18,058	3,500.00	22,066	5,295.84	+22	+ 51
Stores and lofts	2,364	13,329	370.00	1,383	653.30	+ 4	+ 76
Athletic club and hotel†	2,300	22,500	3,500.00	24,705	5,929.20	+ 9	+ 70

*20 per cent of apartments empty. †Steam used for other purposes beside heating.

thirteen are still connected to the central station and are satisfied.

The season of 1910-11 had average weather conditions, but during the season of 1911-12 the temperature was considerably below the average. Accordingly, in this table, on account of the weather conditions, the economies practised by the consumers do not show up very clearly, but the meter records for this season, 1912-13, show in most cases a very large decrease as compared with the corresponding period of the two previous years. This table shows a large increase in the income during the season of 1911-12 as compared with a small increase in steam.

The schedule illustrates the way in which the change to meter basis affects the use of steam. The first result is an increase in the monthly bill. The customer comes to the company to know why the bill has increased and wants to learn some way by which the bill can be cut down. The same suggestions which were disregarded when steam was sold on a flat-rate basis then become very interesting to the customer, and economies are immediately put into operation.

In the discussion which followed the report Mr. E. Darrow, Indianapolis, observed that in operating a district-heating business service is the prime requisite and that a tendency to economize may interfere with the consumer's comfort. Metered service, he added, tends to develop peak-load characteristics, while the flat-rate demand continues twenty-four hours a day.

Mr. H. R. Wetherell, of Peoria, Ill., cited an Illinois city in which the use of meters, he said, had increased the revenue by 50 per cent while cutting the coal bills in half. Experiments which he reported confirmed the suspected fact that under flat-rate conditions a radiator might easily consume twice as much on a 35-deg. day with the windows open as on a zero day with windows properly shut.

Mr. C. R. Bishop, Lockport, N. Y., told of a recording device used in San Francisco by means of which each rotation of the metal test-dial pointer is electrically registered on a Bristol recording instrument, showing the hours of the day or night at which the high demands occurred. The mechanism is operated by a couple of dry cells, and the complete equipment costs only about $20. Clocks are also used to control butterfly values in customers' steam mains, shutting off or turning on the supply at any predetermined time.

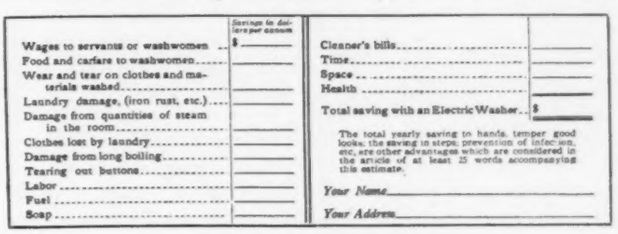
Mr. L. T. Mason, Hornell, N. Y., reported that after fourteen years' operation of a combination electric and steam-heating plant the use of flat rates had made the heating proposition a losing one. Recently, however, meters fact that a greater cubical content was heated during the latter season, the coal consumed decreased by 2763 tons, saving $6,500 in fuel bills.

A Washing-Machine Contest at Chicago

To the person preparing the best arguments setting forth the savings effected by electric washing machines the Electric Shop, Chicago, offers to give an eighty-five-dollar Federal electric washing machine. No conditions are attached to this competition, in which anyone is permitted to take part.

Creation of interest in the machines is, of course, the purpose of the campaign which is being carried out with the aid of newspaper advertising, circular matter and personal solicitation. Following the newspaper advertisements circulars were sent out to a list of 25,000 names, while others were handed to visitors at the Electric Shop. Any person entering into this contest is, of course, already necessarily convinced of the advantages to be gained from the use of the machines, so that the way of the solicitor to make sales is well paved at the outset. To aid contestants in preparing their list of savings, blanks are furnished with spaces for estimating wages, food and car fare for washerwomen and servants, labor, fuel, soap, wear and tear on clothing and materials washed, tearing off buttons, laundry damage and loss, cleaners' bills, time, space occupied, damage from steam, time needed for boiling, and advantage accruing to health.

It had not been expected that many direct sales would be


Savings in dollars per annum
Wages to servants or washwomen $
Food and carfare to washwomen
Wear and tear on clothes and materials washed
Laundry damage, (iron rust, etc.)
Damage from quantities of steam in the room
Clothes lost by laundry
Damage from long boiling
Tearing out buttons
Labor
Fuel
Soap
Cleaner's bills
Time
Space
Health
Total saving with an Electric Washer $
The total yearly saving to hands, temper good looks, the saving in steps, prevention of infection, etc, are other advantages which are considered in the article of at least 25 words accompanying this estimate.
Your Name
Your Address

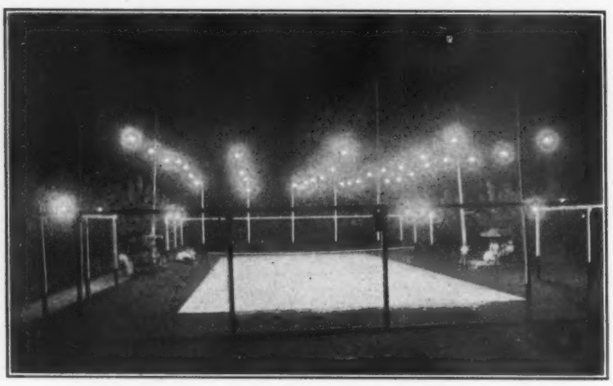
CONTEST ADVERTISEMENT

effected by this advertising, the returns hoped for being principally in the form of general publicity. However, the returns from the newspaper advertising have already been entirely satisfactory, and it is evident that the campaign will be successful financially. The arguments and testimony obtained will also furnish valuable material for use in future advertising campaigns.

Illumination and Wiring

Electrically Lighted Tennis Court

Electricity for lighting tennis courts at night has been introduced in the suburbs of Brooklyn, N. Y., with success. The illustration shows a typical installation at King's Lawn, situated near Ocean Boulevard on the road to Coney Island. This section of Brooklyn is being developed by a



ILLUMINATED TENNIS COURT AT NIGHT

progressive builder, who not only completely equips his houses for electric service but as an added inducement to purchasers of homes offers the free use at night of a regulation tennis court lighted with tungsten lamps. The total equipment consists of fifty-two 100-watt lamps. Forty of the lamps are placed over the court proper, approximately 20 ft. above the ground, and give an excellent distribution of light. The rest are attached to the net framework that surrounds the court. As tennis is played practically every night from sunset to midnight, the consumption of energy is such as to make it a desirable load.

Street-Lighting Changes at Hannibal, Mo.

The street-lighting system of Hannibal, Mo., operated by the local municipal electric plant, has in the last year been changed from 6.6-amp series inclosed arcs to a complete system of series tungsten lighting. The change was made in accordance with plans and recommendations by The Arnold Company of Chicago, which is consulting engineer for the municipality of Hannibal on matters connected with its electric-lighting plant. The engineer made a careful survey of the city, block by block, noting the advisable locations for lamps, and plans were outlined accordingly.

The old system consisted of 116 6.6-amp series inclosed carbon alternating-current arc lamps, of which eighty-five were located on brackets or span wires at street intersections and thirty-one were on eight high steel towers. There were also 118 series 80-cp tungsten lamps operated on the same circuits. The arc lamps were mostly located in the central part of the city and were spaced one block apart.

The general plan adopted in making the change was to substitute a 200-cp series tungsten lamp at all the more important corners in the central part of the city which had been generally served by arc lamps. The towers were taken down. At corners further away from the business center 100-cp series tungsten lamps were used. A total of 415 lamps were installed. The result has been a marked improvement in the illumination. At the same time there has been a reduction in the voltage required for each series circuit, so that with the present series regulators at the station more extensions of the street-lighting system will be possible than if the arcs had been retained.

The financial report of the plant for the year ended May 1, 1913, shows that the expense of the change (which consisted mostly of locating some new lamps and substituting tungsten brackets for arc lamps) was made out of operating expenses, and that still the operating expenses not including depreciation were but 61 per cent of the gross receipts. The city owns a very economical compound condensing plant and sells considerable energy to manufacturers, hence the good showing. The plant is under the supervision of Mr. A. M. Nipper.

Postal-Car Lighting

In an address before the Chicago Section of the Illuminating Engineering Society, June 27, Mr. A. J. Sweet, Milwaukee, Wis., discussed the results obtained from the recent Baltimore & Ohio Railroad postal-car tests, data concerning which were presented in these columns March 29, 1913. Mr. Sweet took part in these experiments, which were conducted at Washington. The subjects investigated included efficiency of various types of lamps and reflectors, shadow effects, eye efficiency, required intensity and distribution of units.

As postal clerks have to work under considerable pressure from eight to ten hours at a stretch, eye fatigue is considered by Mr. Sweet as the governing factor in specifying the amount of illumination required. Tests were conducted with cars stationary and in motion to ascertain whether the amount of illumination required varied any. According to the data obtained, it appears that a car in motion requires less illumination than one standing still. This, however, may be accounted for by the fact that the men who took the stationary readings came into the cars from outside so that their eyes did not become fully accustomed to the artificial light as was the case when the car was in motion and the observers were kept inside all of the time.

Standard postal cars are divided into several sections, each of which had to be studied separately to determine the means of obtaining the best results. In each end of the cars are sack storage portions in which close visual inspection is not required. Sack-rack sections require more illumination, but as experienced postal clerks sort the mail mechanically, the amount of illumination does not have to be so great as would appear at first thought. The letter-case wings, on the other hand, require the best illumination and of such a character that no shadows are cast on the letters which the clerks are sorting. In front of the letter racks, which are arranged on a semi-cylindrical surface, is a sorting table about waist high. Standing as the clerk does in front of this table, it is necessary to receive both vertical and cross light in order to avoid shadows, to prevent direct reflection into the eyes, and to prevent glare on a level with the eyes due to light reflected from the labels on the letter racks.

Advocates of half-deck lighting declare that this system gives more uniform illumination than the center-deck system, but the tests seem to show that for postal-car lighting one system is as good as the other. Mr. Sweet is confident that the half-deck system will become less and less popular, as it causes harmful reflections into the eyes. He favors the center-deck system as less light is reflected in the clerks' eyes when sorting mail.

The best spacing found was 5 ft. center to center, for all types of reflectors with 50-watt lamps. Seven and one-half-foot spacing was also found sufficient, but the arrangement of the car did not permit of dividing the lighting into sections as well as with the 5-ft. spacing, on account of overlapping of the light of the larger units which would have to be used with the longer spacing. Another feature incorporated in the sample specifications drawn up after a study of the data was the placing of the lamps in their

respective reflectors so that when the eye is raised 20 deg. no filament can be seen from any part of the car. The minimum illumination which should be allowed according to these specifications is 2.25 ft.-candles for close, intense work. This value was obtained by taking an average of the minimum readings given by the men running the tests as ample illumination.

Color of head-linings was another subject investigated to see if it had any effect on the amount of useful light received. Even with a change in reflection coefficient of 10 to 50 per cent it was found that the useful light was increased only 10 per cent at the most. As maintenance is a large item in keeping a white ceiling clean, it was considered better to use larger lamps. This statement applies, of course, only to direct illumination; when indirect illumination is employed the color of the head-lining has a considerable effect as one would expect. It was found in these tests that indirect lighting was satisfactory in every case, but the additional energy consumption of such a system would hardly warrant its use on railway cars where storage batteries have to be carried.

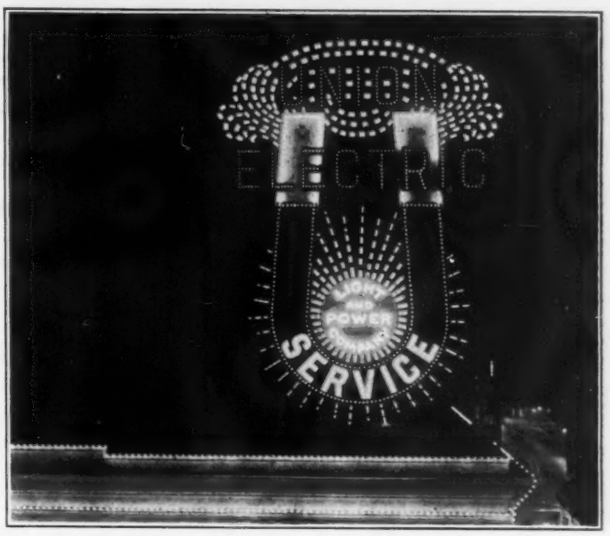
In closing Mr. Sweet said that other types of railway cars and street cars should receive separate study, as each type has to meet different requirements. Experiments being conducted in Cleveland at the present time by the committee on illumination of the Railway Electrical Engineers' Association are intended to apply to railway cars of all types and are being carried out in considerable detail.

House-Wiring Campaigns

Workmen are usually preferred about the house when the doors and windows are open, or better still when no one is at home and the owner is enjoying himself at the seashore or in the mountains. Even the dwellers in flats manage to gain a respite from the heat of the city and are glad if the landlord takes advantage of their absence to make needed repairs or improvements. Therefore the hot summer months open up opportunities for the wiring of old houses and flats which many central-station companies are not backward in grasping. By means of cleverly written and well-illustrated literature the lesson is driven home that the wiring of an old dwelling or apartment does not mean ripping things up, smashing walls and ceilings and leaving the place as though a cyclone had struck it. Electrical contractors who make a specialty of such work manage to complete a wiring job without so much as a speck of dirt, and were it not for the switches and fixtures and the electric light itself the householder would hardly believe that his place had been wired. Even with the visible evidence it is a source of wonder to him how the work could have been done from within without leaving some trace of the workman's hammer. One company that has accomplished quite an amount of this kind of work is the United Electric Light & Power Company, of New York City, and a particularly telling set of photographs of apartments on its circuits in the process of being wired was shown in the *Electrical World* of May 31. Mr. J. Becker, the general sales agent of the company, has been very successful in his active campaign among the owners of unwired dwellings in the uptown sections of New York City, and certainly the work done by the United Electric Light & Power Company indicates very forcibly what might be accomplished elsewhere as well. As shown in the issue noted above, disorder does not attend the wiring of finished houses, and if this is brought to the attention of the owner or tenant, and the cleanliness, convenience, comfort and utility of electricity are accentuated, it ought to be an easy matter to add his name to the list of the company's patrons. The summer season is a particularly opportune time in which to sing the praises of electricity.

St. Louis Company's Trade-Mark Sign

One of the most beautiful of central-station electric-sign displays is that recently completed by the Union Electric Light & Power Company, St. Louis, on the roof of its office building, at Twelfth and Locust Streets. This huge sign, 75 ft. in height and containing 1500 lamps, represents the Union Electric Company's trade-mark, in which a



TRADE-MARK SIGN, ST. LOUIS, MO.

horseshoe magnet and the words "Union Electric Service" are prominent features. The steelwork for the display alone weighs 20 tons, and the roof had to be specially reinforced from the building structure to make sure of supporting this extraordinary weight. Each pole of the magnet is 7 ft. across, and the letters themselves are 7 ft. high. Ten-watt and 25-watt tungsten lamps make up the display, which is controlled by a flasher mechanism that lights parts of the sign in succession, meanwhile keeping up the appearance of flowing movement along the "lines of force" between the poles of the magnet.

The Union Electric Light & Power Company's trade-mark sign here described was erected and is being maintained by the Brilliant Sign Company, St. Louis.

Recent Telephone Patents

Repeater Device

Mr. S. G. Brown, of London, England, is the inventor of a device for reinforcing telephone currents, the novelty lying in the microphonic contact of the retransmitter part. The contact is supported upon a reed of steel and an adjustment is effected partly through magnetic influence. A steady current is carried through both the contact and an adjacent electromagnet, and the contact pressure is automatically adjusted so that it will maintain sufficient current to provide a balanced condition.

Party-Line System

Two patents have recently been issued covering party-line systems in which eavesdropping is made known to the parties who are legitimately using the telephones. In the system patented by Mr. J. W. Nilsson, of Balfour, N. D., a detector is provided which is actuated each time a hook switch moves up or down. These devices, of which there is one at each station, are equipped with a motor which drives a code wheel adjusted to the ringing code of the station at which it is situated. The motor rotates the code wheel once and stops and during this rotation an identifying series of buzzers is introduced upon the line.

Letters to the Editors

The Myriawatt

To the Editors of the Electrical World:

Sirs:—I have read Mr. W. D. Weaver's communication in your issue of June 28 with a great deal of interest as it seems to indicate how difficult it is to present a perfectly plain and simple proposition in such a way that "he who runs may read."

In the first place, as one of the authors of the use of the term "myriawatt," I have endeavored to emphasize on all occasions the fact that it is merely a multiple of the highly respectable watt, and, further, that neither of us has ever meant to discredit its parent, the watt, or its brother, the kilowatt.

Mr. Weaver seems to complain that the myriawatt is meant to be used for a trade name and attached to each boiler as a measure of size. Let me reassure him at once upon this point by referring to the paper presented at the June, 1912, convention of the A. I. E. E. Quoting from the opening paragraph of that paper: "The object of this communication is to introduce a new unit of power which, if adopted, will afford a basis of comparison of all converters of energy, thermal and mechanical, and also will be international in its character, as it is merely a new multiple of the watt." Again quoting from that paper: "The last two are practically the same, differing by only 2 per cent. The usual practice is to rate water-tube boilers on the basis of one boiler-horse-power per 10 sq. ft. of heating surface. "With modern plants, notably those in marine service, operating at from two to five times this rating, the ordinary method of determining nominal boiler capacity could be stretched 2 per cent without materially affecting the present rating; *i.e.*, the boiler might be rated at 34.150 B.t.u. per hour for each 10 sq. ft. of heating surface, instead of at 33.47 B.t.u. per hour for each 10 sq. ft. of heating surface. The myriawatt as a unit of boiler or producer output, and correspondingly a unit of input to all kinds of dynamical machinery is fixed in value by the watt, and by its very sound gives a clew to its meaning."

It is here distinctly recognized that there is no fixed ratio between the heating surface of a boiler and its output in heat units, and further that the existing trade rating of 10 sq. ft. of heating surface is not referred to as a boiler horse-power, but the evaporation of 34.5 lb. of water from and at 212 deg. Fahr. is the unit.

Boilers are now usually sold (as in European practice) upon the basis of square feet of heating surface covered by water, and the term boiler-horse-power is used but rarely in negotiations concerning the purchase of boilers for power purposes, owing to the well-recognized fact that we are able to obtain from three to five times as much output from a given surface as formerly obtained.

Once and for all, then, the myriawatt is *not* meant to apply to boilers but to their input in heat units in the coal or their output in heat units in steam, as well as to other purposes outlined in the paper referred to.

The term boiler-horse-power is, however, one used every day in making tests of the output of boilers, and the necessity of some unit of evaporation is obvious. The accidental discovery that one myriawatt was approximately equal to the heat units required to evaporate 34.5 lb. of water from and at 212 deg. Fahr. naturally suggested the logic of using the international unit of power—the watt—as the common standard for thermodynamic and mechanical, as well as electrical, work.

Mr. Weaver also questions the use of the Greek prefix "myria," as not having the definite meaning of ten thousand. In Webster's Imperial Dictionary, now before me, I find, in addition to the word "myria—ten thousand," the words "myriagram," "myrialiter," "myriameter" and "myriare," in all of which the prefix has the definite meaning of ten thousand. If "myria" is wrong, why is not "kilo" also wrong? Let us be consistent and stick to watts alone and talk about thirty-million-watt machines and about a daily output of one billion two hundred and fifty million three hundred and seventy-five watt-hours.

Mr. Weaver also takes the A. I. E. E. to task for allowing its name to be used in this "attempt to foist on the engineering public as a 'power unit' an existing trade rating." The officers of the A. I. E. E. need no defense at my hands or from any one who takes a proper view of the subject, but it does seem rather late to bring up anew a matter which was printed in the *Proceedings* over a year ago and had given to it the widest publicity in the hope that criticisms might be brought out, and which was again presented to the Institute at the February meeting held under the auspices of the standards committee, and also published in the *Journal* of the A. S. M. E. shortly after.

Part of the resolutions passed unanimously at a joint meeting of the standards committee of the A. I. E. E. and a special committee of the A. S. M. E. read as follows:

(1) "That the two committees in joint session recommend to their respective societies the use of the term myriawatt, as unit of thermal or mechanical power, as indicated in the above-mentioned paper."

(2) "That the two committees also jointly recommend to their respective societies the exclusive use of the myriawatt in connection with boilers, producers, turbines and engines and to discontinue the use of the term boiler-horse-power."

By choosing the myriawatt instead of the kilowatt, we adopted the path of least resistance, as obviously if the kilogram was within 2 per cent of the pound or the meter within 2 per cent of the yard, there would be much less difficulty in securing the adoption of the metric system in this country.

In conclusion let me reiterate the statement that the myriawatt *per se* has nothing to do with the physical dimensions of the boiler, producer, engine or other energy transformer, but only applies to input or output as a convenient multiple of the international unit of power, the watt.

New York, N. Y. H. G. Stott.

The Boiler-Horse-Power

To the Editors of the Electrical World:

Sirs:—In order to keep a previous letter in these columns (June 28) within reasonable bounds as to the space occupied the writer withheld from it a section discussing boiler-horse-power in some detail, which portion is now presented in this communication.

In the earliest days of steam engineering the engine steam supply was expressed in gallons of water per hour per Watt horse-power. This latter rating was established by James Watt on the basis of 33,000 ft.-lb. per minute, with a piston mean steam pressure of 6.94 lb. per sq. in. and piston speeds standardized by stages from 160 ft. per minute for engines of 2-ft. stroke to 256 ft. for 8-ft. stroke. Thus the capacities of engines of different sizes were not directly comparable on the Watt horse-power basis, but it seems to have been assumed that the lesser efficiency of the smaller engines would to some extent compensate for the disparity. Later Watt computed nominal horse-power by multiplying the square of the piston diameter in inches by the cube root of the stroke and dividing by 47.

In the early part of the last century a rating for boilers was established on the basis of 1 cu. ft. of water evaporated per horse-power-hour. Such a rating had early been used, but its general adoption was hastened by a showing that it corresponded nearly to the Watt engine rating. About the same time or soon after two other boiler-horse-power ratings came into use, namely, one based on 1 sq. ft. of grate surface and the other on 1 sq. yd. of heating surface.

As improvements in boilers and engines were made, it

was found that an engine might develop five times or more the power given by the rule of Watt; that in different types of boilers the coal consumption ranged from 5 lb. to 100 lb. per sq. ft. of grate; that the heating surface per cubic foot of water evaporated varied from 5 to 70, and that the ratio of heating to grate surface, instead of being 27 as fixed by the ratio of square yards to square feet, ranged from 15 to 80. To meet these conditions, various coefficients—that last refuge of pseudo-science—were applied to fit the "standard" formulas to different types and sizes of boilers, or purely empirical formulas were substituted, such as one basing the boiler rating on the square root of the sum of the grate and heating surfaces.

An authoritative writer, in commenting more than sixty years ago upon the conditions illustrated in part above, said: "It would have prevented much needless confusion if the duty of the boiler had been entirely separated from that of the engine, as, indeed, they are two very distinct things." And yet at the present day an attempt is being made to re-establish definitely a condition that in the early days of steam engineering led only to confusion and vexation of spirit. While there is no longer so great a disparity among boiler factors as formerly, yet variations in fuel, types of boilers, rate of combustion and evaporation and relative efficiency of heating surfaces remain independent variables that render it impossible to establish, now or ever, even a roughly approximate general relation between boiler and engine capacity.

The present method of rating boilers was first brought forth prominently at the Philadelphia Centennial Exposition of 1876, in the report of a committee including Thurston, Emery and other well-known engineers of the day, to whom had been assigned the task of making economy tests of boilers installed about the exposition grounds. At that time 70 lb. was the usual boiler pressure, and to furnish a standard of comparison an evaporation of 30 lb. of water per hour at this pressure (equivalent to about 34.5 lb. from and at 212 deg.) was taken to represent an engine-horse-power demand. In point of fact, this consumption even at that day applied only to small engines or to larger ones of types already obsolescent. Corliss and related types of engines were at the time being sold on a guaranteed consumption of less than 20 lb. of water, and the multiple expansion engine was already being hailed as the coming type. The only significance in the adoption of the basis of 34.5 lb. of water appears to be that this figure accorded with a prevailing boiler trade-rating situation.

In 1884 the American Society of Mechanical Engineers reaffirmed, though not without opposition from leading engineers, this rating, namely, that a boiler-horse-power "should be considered equal to 34.5 lb. of water evaporated from a feed-water temperature of 212 deg. into steam at the same temperature." In 1899 the subject was again taken up by the society, and for the above clause the following was substituted: "The committee recommends that, so far as possible, the capacity of a boiler be expressed in terms of the number of pounds of water evaporated per hour from and at 212 deg. It does not seem expedient, however, to abandon the widely recognized measure of capacity of stationary or land boilers expressed in terms of boiler-horse-power." At the present time the subject is again before the society, and in a preliminary report the committee in charge, recognizing the validity of these objections to the boiler-horse-power in these days of high steam pressure and steam turbines, recommends the abandonment of the horse-power as a standard of boiler capacity and the adoption as such standard of "1 lb. of water evaporated into dry steam from and at 212 deg. per hour"—relegating to a foot-note the boiler-horse-power with the remark, "A subsidiary unit which may be used for stationary boilers is a 'boiler-horse-power, or 34.5 lb. of water evaporated from and at 212 deg. per hour.'"

Thus, after an inglorious career of almost a century, and at a moment when the boiler-horse-power is being finally abandoned by the steam-engineering profession as an anachronism, a body representing the electrical engineering profession is asked to erect it, in an obsolete value and with all of its inherent defects, to the status of a "new power unit," and, moreover, in such form as forever to make impossible revision of value.

What favor the myriawatt proposition appears to have met with has apparently been through reliance on the assertion of its friends that it represents a decimal relation between boiler and engine capacity, but a moment's reflection will reveal the error of such an assumption. For example, since by definition the myriawatt is the product of the heat units in a pound of steam evaporated from and at 212 deg. (9704) and of a certain definite quantity (a) of water per horse-power-hour, and since there are 3415 heat units in the kilowatt-hour, we have as the boiler and engine ratio the expression $970.4a/3415$. Now, it will at once be apparent that this ratio will only be 10 when the value of a is 35.2, or when an engine-horse-power corresponds to a consumption per hour of 35.2 lb. of steam, an excess of about 2 per cent over the present boiler rating. In the case of the usual larger engine of to-day, taking, say, 15 lb. of steam per hp-hr., the actual ratio would become not 10, but 23; and in the case of a steam turbine using 10 lb. of water the ratio would become 35.2. It will thus be seen that the decimal relation applies only in the solitary case of an engine using, on the 212 deg. basis, 35.2 lb. of steam per hp-hr. The assumed merit of the myriawatt in enabling the thermal efficiency of an engine to be determined almost by inspection is a still more remarkable *jeu d'esprit* than the decimal relation above considered, but its analysis is left to those who have an eye for the curiosities of pseudo-science.

Though somewhat aside from the direct subject of this letter, the apparently growing use of the expression "British thermal unit" and the plentiful sprinkling of "B.t.u." through papers relating to steam engineering seem to excuse some comment on the practice. Formerly American writers were content to use the simple expression heat or thermal unit, or at most to refer to "lb.-Fahr. units" when a distinction was thought to be necessary. If we leave aside the temperature at which the unit of heat is determined and which in any event would introduce a correction entirely too small for recognition in practical calculations, there appears to be no justification whatever for changing to the cumbersome British from the simple American practice, which latter, moreover, accords with modern scientific nomenclature. Our British cousins, from whom we have so unfortunately inherited our abominable system of weights and measures, are surely the last of all to accept as authorities on any kind of engineering nomenclature, for their first impulse appears to be to make such nomenclature militantly British. Thus, to the kilowatt-hour they have applied the name "Board of Trade Unit" (B. T. U.), and it is only recently that they have, after twenty years, commenced to follow the rest of the world in substituting I for C as the symbol for current. There are other ways of paying a tribute of admiration to a great country and a gifted people than by copying their foibles.

Charlottesville, Va. W. D. WEAVER.

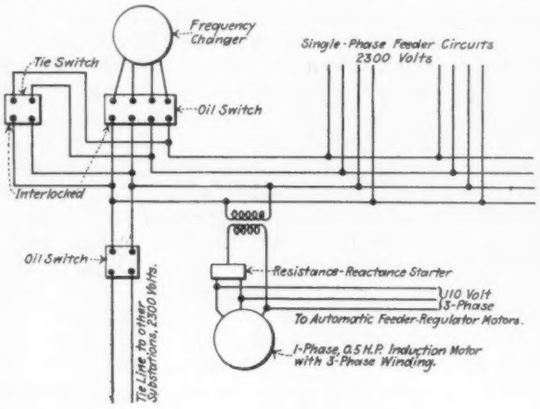
[The quantity to which it has been proposed to apply the term "myriawatt" is represented by the amount of heat units required to evaporate during a certain time interval a certain amount of water under specified conditions. It is not only approximately, but accurately, equal to ten kilowatts. Fortunately, the old "boiler-horse-power," which is a constant quantity in itself but bears a variable ratio to the variable quantity of steam required for producing a horse-power in engines of different types, is approximately equal to one myriawatt, and the birth of the myriawatt means the death of the boiler-horse-power.—EDS.]

Field of the Operating Engineer

A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

Polyphase Feeder-Regulator Motors Operated from Single-Phase Feeder Circuit

It is quite generally known that a three-phase motor operating on a single-phase system will supply three-phase energy at its terminals. The principle has been applied by the Kansas City Electric Light Company, of Kansas City, Mo., in one of its substations. During light loads the frequency changer in one of the electric-service company's substations is shut down, and single-phase energy is supplied over a single-phase tie-line from another substation. The frequency changer when operating supplies two-phase energy, which is distributed to single-phase feeder circuits in such a way as to maintain a balanced system.



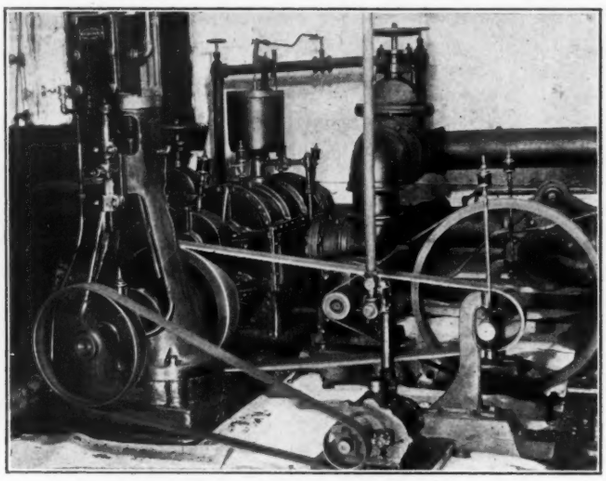
CONNECTION DIAGRAM FOR OPERATING AUTOMATIC FEEDER-REGULATOR MOTORS FROM SINGLE-PHASE SYSTEM

As the automatic feeder-regulator motors require polyphase current for operation, an induction motor, connected as shown in the diagram, is employed to furnish three-phase energy when the frequency changer is shut down. Although rated as a 0.5-hp single-phase machine, the motor is equipped with three-phase windings. A step-down transformer supplies the energy needed for the motor. A resistance-reactance starter is connected between the motor and one of the low-tension terminals of the transformer for starting on single-phase energy. With the arrangement shown in the diagram, it would be possible to operate the apparatus from a distance.

Conversion of Steam-Driven Gas Exhauster to Motor Drive

The combination plant at Mankato, Minn., furnishes gas, electric-lighting and street-railway service, its electrical section being operated in conjunction with the Rapidan hydroelectric station a few miles distant. Formerly the rotary exhauster for the gas plant was driven by a small vertical engine, but with the hydroelectric plant supplying all the power needs of the community steam frequently had to be kept up to supply this single auxiliary. Now motor-drive has been substituted for the exhauster engine with a saving in coal.

As shown in the illustration, a 3-hp motor was attached to a short jack-shaft and connected with the flywheel of the engine, the piston-rod and eccentric gear having meanwhile been disconnected. This gives a steady and regular speed to the exhauster. The regulation to carry the proper vacuum on the hydraulic mains is made with the same float which before operated on the butterfly valve at the throttle of the steam engine, but which is now connected to a butterfly valve installed on a by-pass line of pipe, tapping the inlet and outlet of the exhauster. In this way a certain amount of gas is allowed to return to the inlet side, should the exhauster be operating at a speed more than sufficient for the proper vacuum on the hydraulic main.



3-HP MOTOR DRIVING A GAS EXHAUSTER THROUGH A SHORT JACK-SHAFT AND ENGINE SHAFT

The arrangement, according to Mr. R. E. Brown, manager for the Consumers' Power Company at Mankato, saves a ton of coal a day, for it was formerly necessary to keep steam up in a 150-hp boiler, the smallest unit in the station, in order to run the exhauster engine.

Water-Spray Filter for Turbo-Generator Ventilation

All air about a power house, no matter how cleanly the surroundings may be, is heavily charged with dust and fine gritty particles in suspension, and unless care is taken to filter it before passing though machines to be ventilated, the windings become coated and the air ducts choked up, and with the consequent rise in temperature the efficiency of the machine rapidly falls off.

Where no filters are provided, the varnish and insulating fabric on the end windings become in time seriously affected by the heat and the constant sandblast action due to grit-charged air moving at high velocity over their surface, thus making it porous. If a machine in this condition is allowed to cool down in a humid atmosphere, the insulation, from the absorption of moisture, rapidly falls below a safe figure, which is probably the real cause of many mysterious "burn-outs" for which it has been difficult to account.

The type of air filter in common use consists of closely woven cloth, tightly stretched on wooden or wickerwork frames. The general practice is to allow one-fifth of a square foot of filter medium per cubic foot of air per minute, or 1 sq. ft. of area per kilowatt of rated output. In the case of large machines this becomes a most unwieldy surface to handle efficiently.

In a paper before the Incorporated Municipal Electrical Association at London, June 19, Mr. J. Christie, engineer and manager of the Brighton (England) municipal plant, described an improved type of water-spray filter which is in use at his Southwick generating station. This equipment consists of a strong rectangular galvanized sheet-iron chamber, one end (the air intake) being open and fitted with louvers.

This filter is installed in the basement adjacent to the machine foundations and 2 ft. inside the air inlet a water screen is fitted. This consists of a series of small nozzles spaced 6 in. apart uniformly over the entire area. Some 6 ft. beyond the screen a moisture eliminator is fixed. This is a sort of baffle, very similar to that used in an oil separator such as is fitted in the exhaust steam pipe between the low-presssure cylinder of a reciprocating engine and the condenser. Thence the air passes directly into the alternator.

The base of the chamber forms a fresh-water tank holding 300 gal., and is fitted with a ball cock to keep the level constant and to make up for any evaporation.

A 2-hp motor-driven centrifugal pump circulates this water at a pressure of 20 lb. to 25 lb. per square inch through the system. The nozzles project this water in the form of a finely atomized spray directly against the incoming air. When the apparatus is working, the spray has the appearance of a dense steamy bank of clouds. All solid matter in suspension in the air is caught and precipitated in the tank. Any beads of moisture or grit carried through with the air are effectively trapped by the eliminator, and nothing but pure cool humid air is carried into the machine. In some localities during the winter months with this class of filter it will be desirable to fit a small steam coil in the water tank just sufficient to keep the water from freezing.

The advantages of the water-screen filter over the cloth type are its compactness, absence of fire risk, simplicity of cleaning, low resistance to passage of air, and incidental cooling of the air enabling the machine to carry overloads of 10 to 15 per cent.

The apparatus can be quickly and easily cleaned, it being only necessary to drain off the water at intervals depending on the amount of dirt in the air (once every two weeks or so), wash out the tank with a hose pipe, fill up and start the pump again. All this can be done in a few minutes and without even taking the machine off load.

The resistance to the air is always constant, and is less than one-third that of a cloth filter, so that the power for driving the main fan is proportionately less, while the total energy consumed by the outfit as a whole shows a substantial saving over that required by a cloth filter, after making allowance for the circulating pump.

The air passing through the filter is not only pure, but is generally several degrees colder than the surrounding air, due to its being reduced to wet bulb temperature, consequently its cooling effect on the machine, volume for volume of air, is proportionately greater, this difference in temperature being generally most marked in the summer time just when the extra cooling effect is of the greatest value.

In tropical climates or in situations where the surrounding air is at an abnormally high temperature, it is posssible, by introducing a small refrigerating plant into the water-circulating system, to "super-cool" and control the temperature of the air down to a degree far below the corresponding wet-bulb temperature.

The first cost of a water-screen filter, of course, varies with the size of the alternator to which it is fixed. In machines of, say, up to 3000 kw it is some 60 per cent greater than a cloth filter, but in the case of machines of 5000 kw and upward, the advantage lies with the water-screen type.

Owing to the increased cooling effect obtained, especially during hot weather, an extra 10 to 15 per cent overload can

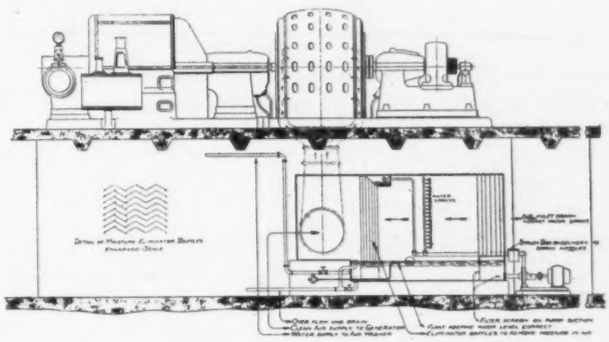


DIAGRAM SHOWING AIR PATHS THROUGH AIR WASHER AND AIR DUCTS OF GENERATOR

be carried on any machine so equipped without increasing the temperature rise, and if a super-cooling refrigerator is fitted in the water system, this overload capacity can be still further increased to 25 or 30 per cent. In the near future, predicted Mr. Christie, turbines of ample power to carry extra heavy overloads will always be provided. The attendant will then simply load up the alternators to which they are coupled till their temperature attains a predetermined maximum safe limit, electrically controlled thermometers on the switchboard superseding the ampere and wattmeters now used. Under such conditions the limiting load on a machine will not be governed by its nominal rating, but by its actual ability to do the work without overheating.

Protection Against Ultra-Violet Light

What kind of glass is necessary to protect the eyes against ultra-violet light, without interfering with the passage of ordinary light? W. L. L.

Ordinary glass is quite opaque to ultra-violet rays and will fully protect the eyesight while admitting the passage of ordinary visual wave-lengths. In the mercury-vapor arc, for example, a large amount of ultra-violet radiation is produced, but where such an arc is inclosed in a glass tube or outer globe the ultra-violet waves are practically entirely cut off and their destructive effects rendered harmless.

Parallel Operation

If four alternators in a station are operating in parallel and it is desired to "tie in" the station with a like system at times of peak load, is it possible to synchronize the entire station with the other system, or must the alternators be transferred and synchronized one by one? The four alternators in the home station and the machine of the exterior system spoken of are operating at approximately the same frequency and voltage.

R. B. C.

It is possible under the conditions given to synchronize the two generating systems. The speed and voltage of the home station may be manipulated to bring the two systems into step, for if the speed or voltage of one alternator of the four is changed slightly the others, being in synchronism with it, will be caused automatically to follow the change. When a period of synchronism between the two systems is secured as indicated by the synchroscope or synchronizing lamps it is only necessary to close the switch connecting the home station buses to the tie line, as in any other paralleling operation.

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

Air Filtration, Cooling and Ventilation of Electrical Machinery.—J. Christie.—A paper read before the British Municipal Electrical Association on air filtration, cooling and ventilation of large steam turbo-driven alternators, in which the importance of removing the dust and fine gritty particles from the forced-draft air was pointed out and the disadvantages of the ordinary air filter were discussed. The author described the wet system of "air-conditioning chamber," which he has employed successfully with the latest alternator installed at his plant.—London *Electrician*, June 20, 1913.

Damping Alternating Oscillations.—A note on a recent British patent (No. 11,957, 1912) of the Siemens-Schuckert Company. A heavy flywheel is connected to each machine through a spring coupling in which considerable friction is set up by the relative displacements of the parts. Alternatively the frictional resistance due to the movement of a liquid in a restricted part of a vessel rigidly attached to the machine may be used.—London *Elec. Eng'ing*, June 19, 1913.

Lamps and Lighting

Sealing Wires in Glass.—A note on a recent British patent (No. 15,342, 1912) of the British Thomson-Houston Company and the General Electric Company of this country. Iron-chromium alloys containing from 20 to 30 per cent of chromium have the same temperature-expansion coefficient as has lead glass and adhere to the glass so as to make a perfectly vacuum-tight seat.—London *Elec. Eng'ing*, June 5, 1913.

Selective Radiation.—W. W. Coblentz.—The fourth paper of his long serial on selective radiation from various substances. The first deals with the radiation constants of platinum and reaches again the conclusion that there are no real radiation "constants" for metals. The author then discusses the emission of spectra of neon, helium, and mercury; the emissivity of different parts of an acetylene flame; the variation of emissivity with the thickness of the radiating layer; the radiation from a uniformly heated cavity and from its inclosing walls, and standard spectral-energy curves. Some notes are added on light filters which absorb all the infra-red and on the transmission of prism materials.—*Bulletin Bureau of Standards*, Vol. IX, No. 1, 1913.

Alternating-Current Mercury-Vapor Lamps.—A note on a recent British patent (No. 11,870, 1912) of E. E. Darmois and M. A. E. LeBlanc. An inductance is connected in series with the lamp which has a pair of electrodes for each phase. The supply pressure across the lamp and inductance must not be less than 800 volts at 50 cycles per second. To start up the lamp, it is heated by surrounding the tube adjacent to one electrode with a metallic conductor connected to the other electrode. To reduce the temperature of the mercury electrodes, iron, nickel or other metal with a higher thermal conductivity is inserted in the mercury.—London *Elec. Eng'ing*, June 12, 1913.

Street-Car Lighting.—S. G. Hibben and E. M. Smith.—An illustrated article in which the authors show that the tungsten lamp with shades greatly reduces lighting costs, the reduction in a railway system operating 1000 cars being at least $13,000 a year and probably $15,000, as the life of the lamps exceeds 800 hours. The resultant useful illumination can be increased 80 per cent, while cost reduction is about 40 per cent. With tungsten lamps voltage variations will not cause such large candle-power variations as occur with carbon lamps. Continuous lighting service may be secured by means of a selector switch or an equivalent device. Lamps placed deep in intensive reflecting shades are optically harmless, and the complete unit becomes pleasing.—*Elec. Journal*, June, 1913.

Generation, Transmission and Distribution

London Electricity Supply.—A long illustrated article and an editorial on the electricity supply of London. In 1892 there were eleven supply companies in London, and this number is thought to have been quite sufficient. But at about that time the municipal spirit seems to have sprung up very vigorously, with the result that in later years, although the number of companies did not increase very materially, there was a very large growth of undertakings owned by London municipal authorities. Thus at the present time London is served by seventeen companies and fourteen local authorities. The effect of this has been to divide London into a large number of comparatively small areas, more particularly on the north side of the river. On the south side of the river the areas are chiefly controlled by companies and are larger. Generation on a large scale and therefore at low cost has been largely hampered by short-sighted municipal policy. Two later schemes to provide a remedy have failed. The requirements of the different districts in London are very different. Some are large factory districts, others are purely residential districts. In some electric heating and cooking are of almost vital importance; in others they are quite neglected. It is thought that the railways should get their energy supply from the lighting stations, but so far only one railway company is doing so. Notwithstanding all the disadvantages "the prices in London compare generally very favorably with those in large cities in other parts of the world. For example, the price for energy supplied for lighting appears to be considerably lower in London than in Berlin, and the same is true for energy for motor service. A mean price of about 2 cents per kw-hr. for motor service is no small achievement." Concise illustrated notes are given on the energy supply from the following stations: Brompton and Kensington Electricity Supply Company, City of London Electric Lighting Company, Hackney Borough Council, Hampstead Borough Council, London Electric Supply Corporation, Metropolitan Electric Supply Company, Poplar Borough Council, St. Marylebone Borough Council, St. Pancras Borough Council, Shoreditch Borough Council, Stepney Borough Council, West Ham Corporation, Westminster Electric Supply Corporation.—London *Electrician*, June 13, 1913.

Corona Losses.—Weidig and Jensch.—The conclusion of their article illustrated by diagrams. The wave-form of the voltage curve is of considerable influence on the losses. If the maximum voltage is the same, the corona losses are greater for a wave-form with a flat maximum than for a wave-form with a pointed maximum. Results are then given of measurements of the corona losses on a line consisting of two wires in parallel. The effect of the frequency is next discussed. The corona losses increase with the frequency. The relation between the losses and frequency is given by a linear function, but the losses are

not proportional to the frequency. The authors then discuss the phenomena in the moment when the corona losses are beginning to manifest those. A comparison is next given between the results of the measurements with those calculated from formulas. Finally oscillographs are given of the starting and final periods of the corona phenomena.—*Elek. Zeit.*, June 12, 1913.

Distribution of Electrical Energy Over Large Districts.—G. KLINGENBERG.—The first part of a long and profusely illustrated paper to be presented at the next meeting of the German Association of Electrical Engineers. The author emphasizes that exact calculations of transmission lines have little practical importance and that approximate methods are sufficient. He gives some general principles of the configuration of networks and then deals with the architectural design of large transformer stations. The paper is to be continued.—*Elek. Zeit.*, June 19, 1913.

Transmission Line.—A profusely illustrated description of the high-tension transmission line and the substations of the Central Georgia Transmission Company.—*Elek. Zeit.*, June 12, 1913.

Mechanical Gearing.—Illustrated notes on some mechanical gearing systems of British companies for the speed reduction of steam turbines.—London *Electrician*, June 13, 1913.

Traction

Electric Tramways in Germany.—G. DETTMAR.—Statistical data on electric traction in Germany in 1911 on the basis of the statistics of German street railways and light railways. The statistics cover 550 lines, and out of this 210 are electric, namely, 191 street railways and 19 interurban railways. Since the statistics in the whole cover 246 street railways, 84 per cent of all German street railways are electrically operated. The total track length of German electric traction lines was 4915 km (2950 miles), the number of cars 21,309, the capital invested $298,000,000, the average interest 5.48 per cent (against 4.34 per cent in 1908). The total number of passengers transported during the year was 2,615,400,000. The voltage used is increasing.—*Elek. Zeit.*, June 12, 1913.

Railway Station.—A description of the Lot's Road station of the underground electric railways in London. This is the largest power house in London and supplies energy over the Metropolitan district, the Baker Street and Waterloo, the Charing Cross and Hampstead and the Great Northern & Brompton railways. These aggregate about 46 miles of double track. The average energy consumed per day is 450,000 kw-hr., giving at times a maximum demand of 42,000 kw. The generators for supplying energy to these lines are centralized in a station at Lot's Road, from which energy is transmitted on a three-phase system at 11,000 volts and 33 cycles to twenty-five substations dispersed along the routes. From the substations the energy is distributed on a direct-current 600-volt third-rail and fourth-rail system. The Lot's Road station has a total rating of 48,000 kw, there being eight 6000-kw turbine sets capable of carrying 50 per cent overload for two hours.—London *Electrician*, June 13, 1913.

Tramway Track, 1883 to 1913.—F. BLAND.—A paper read at the Blackpool congress of the Tramways and Light Railways Association. The author gives a historical account of the methods of track construction employed on tramways, dealing with points and crossings, rail joints and junctions.—London *Electrician*, June 20, 1913.

Railless Traction.—H. ENGLAND.—A paper read at the Blackpool congress of the Tramways and Light Railways Association. The author deals with the progress of railless traction legislation and afterward examines in detail the various provisions in the bills that have been introduced for this purpose in Great Britain. Some operating costs of the systems already at work in England are also given.—London *Electrician*, June 20, 1913.

Increasing Profits on Interurban Tramways.—E. H. EDWARDES.—A paper read at the Blackpool Congress of the Tramways and Light Railways Association. Dealing with the two main questions of how tramway costs can be reduced and the receipts increased, the author pleads for simplicity in construction and suggests the inauguration of a freight-carrying scheme, especially in industrial districts such as are to be found in Lancashire.—London *Electrician*, June 20, 1913.

Electric Automobiles.—W. H. L. WATSON AND R. J. MITCHELL.—A paper read before the British Municipal Electrical Association. The authors deal with the possibilities of the employment of electric vehicles in England and show the suitability of such a vehicle fitted with an Edison accumulator for this work. Results of operating such vehicles and their general design are described.—London *Electrician*, June 20, 1913.

Rules for Tramway Employees.—A. V. MASON.—A paper read at the Blackpool congress of the Tramways and Light Railways Association. The author discusses some points of interest and controversy in "Rules and Regulations for the Tramway Employees," recently published by the Tramways and Light Railways Association.—London *Electrician*, June 20, 1913.

Wires, Wiring and Conduits

Feeder Protection.—A note on a recent British patent (No. 11,559, 1912) of E. G. Waters. Should one of two parallel cables become faulty it is cut out. To effect this the primaries of two series transformers are connected in the feeder circuits, while the secondaries are connected in opposition through wattmeters or reverse-power relays operating separate circuit-breakers in the respective feeders. In addition two other series transformers with primaries similarly connected and secondaries cross-connected are used, so that normally little choking action is obtained, but on the occurrence of a fault the impedance of the combination is greatly increased and the power available for cutting out the faulty main is increased.—London *Elec. Eng'ing*, June 19, 1913.

Grounding.—The proposed rules of the German Association of Electrical Engineers on protective grounding.—*Elek. Zeit.*, June 12, 1913.

Ionization in Gases and Gaseous Mixtures by Roentgen and Electronic Radiations.—C. G. BARKLA AND A. J. PHILPOT.—An account of an experimental investigation in which the relative ionizations produced in various gases and vapors by the complete absorption of corpuscular radiations set free by homogeneous X-radiations were determined. No change of relative ionization with velocity of the ionizing corpuscles was observed. The relative ionizations due to complete absorption of corpuscular radiation were found to agree closely with the relative ionizations due to complete absorption of a Roentgen radiation and all its secondary radiations. The results indicate that the complete absorption of a given X-radiation by different gases results in the emission of the same number of corpuscles. The ionization coefficients for homogeneous X-radiations in a number of gases and vapors were determined, and the generality of the laws given by one of the authors was further verified. The ionizations in gaseous mixtures due to the complete absorption of corpuscular radiation were determined. On the most obvious and most probable interpretation of the results these indicate the relative numbers of ions produced in the two constituent gases of a gaseous mixture. In C_3H_5Br and air the relative absorptions of energy were found very closely in agreement with the relative masses of C_3H_5Br and air. The ionization of X-rays of gaseous mixtures has been shown to differ considerably from the sum of the ionizations in the two individual gases. The difference shows the effect of corpuscles from one gas being absorbed by the other, the nature of the deviation being what could be foretold from the authors' experiments on ionization by

corpuscular radiation. The magnitude of the effect, however, is not so great as should be expected on the simplest theory of ionization by ejected corpuscles alone. The possible causes have been discussed.—*Philos. Mag.*, June, 1913.

Ionization by Charged Particles.—Norman Campbell.—A paper in which the existing information as to the emission of delta rays is reviewed. Some new experiments on the delta rays excited by very slow beta rays are described. They are in complete accordance with the work of von Baeyer and Gehrts and provide little new information. An attempt is made to discuss the experimental results on the basis of the theory of ionization by moving charged particles put forward by Sir J. J. Thomson. It is concluded that, while that theory cannot at present provide a complete explanation of the facts, it is qualitatively in agreement with them.—*Philos. Mag.*, June, 1913.

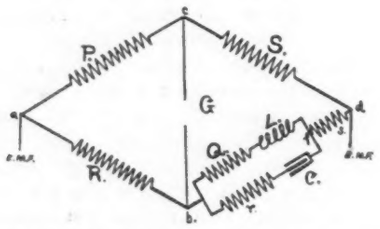
Electrochemistry and Batteries

Electric Iron-Ore Reduction.—John Crawford.—A profusely illustrated account of the latest advances of electric iron smelting at the plant of the Noble Electric Steel Company, in Heroult, Cal. The differences in furnace design and operation from Scandinavian practice are explained as the result of the local California conditions.—*Met. and Chem. Eng'ing*, July, 1913.

Electro-Analysis.—J. G. Fairchild.—An illustrated article on the electro-analysis of copper alloys with rules on the determination of tin, phosphorus, copper, zinc, iron, manganese and nickel and suggestions on the analysis of white metals. Some precautions to be taken are mentioned.—*Met. and Chem. Eng'ing*, July, 1913.

Units, Measurements and Instruments

Comparing Inductance and Capacity.—W. E. Forsythe.—In comparing inductance and capacity by the ordinary bridge methods it is often difficult to know just what resistance to choose. This is due to the fact that there are generally two conditions of balance, the first the steady-current balance, and the second the one due to the reactance, the second condition in general depending on the first. It often happens that with the capacity and inductance to be compared the first balance will be so chosen that the second balance cannot be obtained. The author describes the method in which the two conditions of balance are practically independent. The arrangement of the circuit is given in the cut, where *P*, *R*, *S*, *Q*, *r*, *s* are non-inductive



CONNECTIONS FOR COMPARING INDUCTANCE AND CAPACITY

resistances, *L*, the reductance, being compared with the capacity *C*. The author then shows mathematically that there are three conditions of balance, namely, (1) $S = s + Q$; (2) $S = s + r$; (3) $L = r^2C$. From (1) and (2) it is seen that Q must equal r. Thus, to balance the bridge, set $Q = r$, and then with direct current on the bridge, obtain the steady-current balance, $Q + s = S$. Then with the alternating emf applied to the bridge obtain the inductive balance, with either an alternating-current galvanometer or a telephone. This last balance is obtained by shifting from Q to s, keeping at the same time $r = Q$. Thus, while the bridge has three conditions of balance, two of these due to the reactance can be set at the same time without disturbing the steady-current balance.—*Phys. Review*, June, 1913.

Precision Resistors for High-Frequency Alternating Currents.—K. W. Wagner and A. Wertheimer.—The first part of an investigation carried out in the German telegraph experiment station on precision resistors for high-frequency alternating currents. In the present instalment the authors discuss the time-constant of resistance coils, a method for measuring the time-constant of coils of medium and high resistance, the modification of this method into a substitution method, the construction of the resistances of comparison and a method of measurement for coils of low resistance, and give the results of measurements.—*Elek. Zeit.*, May 29, 1913.

National Physical Laboratory.—A continuation of the annual report of the work of the (British) National Physical Laboratory in 1912. The present instalment deals with the work on the Lorenz apparatus; mercury standards of resistance, wire standards of resistance, resistance bridges, the Weston standard cell, comparison of resistance with mutual inductance and evaluation of the ohm in absolute units, power-factors of condensers and change of capacity with frequency, capacity effects in mutual inductometer, condensers for high frequencies, wave-meter tests, magnetic tests, areas of magnetic search coils, the low-frequency microphone hummer, etc.—London *Electrician*, May 30, 1913.

Insulating Materials.—The proposed regulations of the German Association of Electrical Engineers on testing electrical insulators.—*Elek. Zeit.*, June 12, 1913.

Meters and Measuring Transformers.—The proposed rules of the German Association of Electrical Engineers on the conditions which electric meters and measuring transformers must fulfil to be certified.—*Elek. Zeit.*, June 12, 1913.

Telegraphy, Telephony and Signals

Telephone Transmission Calculations.—A. J. Aldridge.—The conclusion of the illustrated paper in which the author considers the theory of telephonic transmission from the non-mathematical point of view, describing an apparatus for simplifying the calculations and showing its applications to various problems. In the present instalment the results of experiments are given with respect to the predominant frequency of the voice and the harmonic composition of the waves produced by continuously repeating, 1, 2, 3, 4, 5. The voices of five men and one woman were tested. The volume of any voice is fixed by the sum of the volumes of the various components, the higher harmonics giving chiefly the effects of quality and articulation. In all the cases considered the fundamental was of the order of 5 per cent of the principal harmonic, and it is evident, therefore, that the harmonic is by far the most important factor for telephonic purposes. The results seem to show that the voice may be represented by a very low value fundamental of about 160 and a large fifth harmonic of 800 cycles per second. For practical purposes only the fifth harmonic need be considered. The author concludes with some notes on the use of a single frequency for general testing. An account of the discussion which followed is also given.—London *Electrician*, June 13, 1913.

Antenna Resistance.—L. W. Austin.—The author describes tests in which three methods for measuring the resistance of an antenna as a function of the wave-length are compared. The first is the substitution of an air-condenser in place of the antenna and ground, the second is the decrement method of determining resistance, and the third is based on the Bjerkness equation of the current square in the second of two coupled circuits. The first is the most accurate method and the last is the least so, but by far the simplest for ordinary station testing. Various diagrams give the results of measurements of the resistances of a number of antennas, both at shore stations and on ships.—*Bulletin Bureau of Standards*, Volume IX, No. 1, 1913.

High-Frequency Wave Filters.—G. M. B. Shepherd.—The use of a periodic loaded line, or an arrangement of

condensers and inductances electrically equivalent to same, as a wave-form filter or sieve. The theory of wave filters is considered, and constructional particulars based on practical experience are given of such a filter for telephonic work.—London *Electrician*, June 13, 1913.

Miscellaneous

Tramways and Light Railways Association.—An account of the fifth congress of the Tramways and Light Railways Association held at Blackpool, England. The attendance was nearly 300.—London *Electrician*, June 20, 1913.

Book Reviews

THE YEAR-BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY, 1913. London: The Marconi Press Agency. Fully illustrated. Supplemented by a wireless map of the world. 564 pages. Price, 2s. 6d.

This is the first of a series of annuals intended to summarize yearly progress in radio-telegraphy and telephony. The volume at hand contains, in a form convenient for reference, much material of value to technical as well as lay readers, and should prove of unquestioned utility to the many workers in the commercial fields which bear upon and make use of wireless signaling. It is scarcely to be expected that the historical portion of the book would emphasize or even do full justice to all whose efforts have combined to develop the modern practice of radio-communication to its present efficient form, so that scantiness or absence of reference to scientists not directly allied with the various Marconi interests will prove no more disappointing than has the similar treatment given in several earlier and otherwise excellent treatises on the art. The sections including the entire London convention and the various national regulations governing wireless telegraphy will be useful to those concerned with conditions of working in foreign countries, while a collection of the fundamental mathematical relations underlying the design of radio instruments and a brief five-language dictionary of technical terms should be of direct interest to engineers. In addition to general data, the book contains a discussion of British patents and a number of well-presented scientific articles. Dr. Eccles' comments on the facts and theories of long-distance signaling are especially worth reading, and several descriptions of instruments and methods used by the Marconi companies are attractively brought forward. The volume contains a large number of illustrations and, when its purpose is considered, can be criticised only on the score of insufficient indexing. It is hoped that in such future editions as may appear there will be more detailed alphabetical references to both text and illustrations.

THE ELECTRIC PROPULSION OF SHIPS. By H. M. Hobart. London and New York: Harper & Brothers. 167 pages, 44 illus. Price, $2.

A timely book on a new and exceedingly important application of the electrical conversion and transmission of energy for marine propulsion. As is well known, the screw propeller is essentially a slow-speed machine, and ever since its earliest applications it has been standard practice to drive it by slow-speed directly connected reciprocating engines. The advent of the steam turbine, which is essentially a high-speed, non-reversible engine, did not at first seem to have any perceptible influence upon marine practice. Nevertheless, its high economy of both fuel and space encouraged efforts to reach a compromise speed, somewhat too high for best propeller efficiency and too low for best turbine efficiency, in order to secure direct turbine drive. Others devoted their efforts to developing spur reduction gears, with considerable success. But the most flexible and efficient of all speed reduction gearing appears to be the electric drive.

The author in his treatment of the subject seems both conservative and fair, and in order to make his plea for electric propulsion the more appealing, considers the whole question of ship propulsion from all standpoints. In his introductory chapter he very clearly states his purpose as endeavoring to provide a bridge over which the marine engineer may journey into the electrical engineer's territory and obtain an understanding of the latter's enthusiasm over the probability that there is a legitimate and fairly wide field for electrical machinery in ship propulsion. There are sixteen chapters in all, devoted to the size, resistance, momentum and power consumption of ships, efficiency of propellers, different types of prime movers, speed-reducing gears, and the various proposals for electrical speed reduction. The volume will be most instructive reading for every engineer who desires to inform himself on the developments in this field and its most recent aspects.

ELECTRIC ARCS. Experiments Upon Arcs Between Different Electrodes in Various Environments and Their Explanation. By Clement D. Child, Ph.D., professor of physics at Colgate University. New York: D. Van Nostrand Company. 203 pages, 58 illus. Price, $2.

A perusal of this work will serve to show the complexity of the conditions and the unexpected difficulties one meets with in exploring the physics of the electric arc. In many cases the laws that govern the phenomena of the arc are not known, despite all the work that has been done. The author has, therefore, adopted the satisfactory course of giving an extended review of what experimenters have thought about the laws and also a discussion of results obtained. For the benefit of the reader who would like to pursue the subject further, to each chapter there have been appended copious references to original papers bearing on the theoretical aspect of the subject.

AMERICAN TELEGRAPH PRACTICE. By Donald McNicol. 1913. New York: McGraw-Hill Book Company. 507 pages, illus. Price, $4.

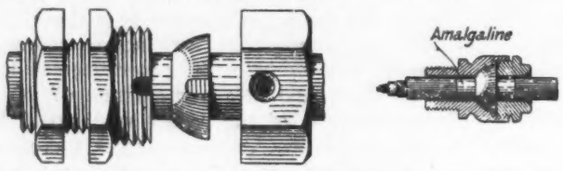
A textbook on American telegraph systems and equipment based to a large extent on a series of lectures recently delivered by the author in the evening technical schools connected with Columbia University. The author states that his aim has been to present a detailed exposition of the various systems of telegraphy in use in this country at the present time, together with a complete description of modern methods of operation and an extensive compilation of the formulas used in practical telegraphy. In view of the subject matter, the title is perhaps too comprehensive, since overhead and underground line construction are not included, although there is a chapter on specifications for wires and cables; neither is there anything on traffic handling or office layouts. Out of twenty-four chapters, there are fourteen on circuits and equipment and these form the real meat of the book. In this treatment practically all the telegraph systems in use in America are very well described, excepting possibly the leased-wire system of the American Telephone & Telegraph Company. Only one chapter is devoted to high-speed automatic telegraphy, a limitation which seems to be justified by its comparatively limited use by American companies. However, a very good condensed bibliography of the literature on such systems is given in an appendix. A special chapter is also devoted to simultaneous telegraphy and telephony. One important respect in which the author could have increased the value of his treatise is by making frequent reference to the authoritative literature of the art, and in general acknowledging the sources of data or information drawn upon. On the whole the volume can be well recommended as a textbook for students of telegraphy and for superintendents, managers, operators, wire chiefs and plant employees in general. The typography and illustrations are excellent.

New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Water-Tight Glands for Bulkheads

A device which makes it possible to pass wires and cables through ship bulkheads and other water-tight compartments has recently been designed by Mr. T. Harden and is being put on the market by the Metal Jointing Company, Ltd., of Adelphi House, London. The gland consists of a steel cup and back-nut which bear upon a hemisphere of lead cast to the sheath of the cable. To install the gland the lead sheath of the cable is first wrapped with a special alloy called "amalgaline," and then the back-nut, shown in Fig. 1, is screwed up until the pouring holes are vertical. The molten metal is poured through these holes to fill the hollow space and form the hemisphere of lead. The nut can then be backed away and the lead sprue or runner sheared off. The illustration (Fig. 2) of a section of a



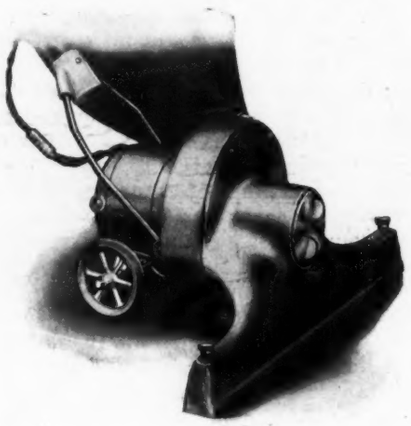
FIGS. 1 AND 2—SIDE VIEW AND PARTIAL SECTION OF GLAND

gland for smaller wiring shows how the cup and nut bear against each other, thus preventing the entrance of water. It will be noted that even though the pressure brought to bear on the nut is very severe, damage to the cable sheath will not result, because the stress is exerted in a longitudinal direction on the hemisphere of cast lead and not upon the sheath itself.

It is stated that these glands, which are being made in several different styles, have been appproved and adopted by the Admiralty following a series of tests carried on to discover any possible mechanical or electrical weaknesses.

Electric Vacuum Cleaner

A new electrically operated vacuum cleaner has been put on the market by the Hurley Machine Company, Chicago, the claim being made that this apparatus cannot become clogged with lint, threads or ravelings, because of the construction of the nozzle and the suction fan. Both the cleaning nozzle and the motor driving the fan are mounted on three small rubbed-tired wheels in such a manner that the nozzle is raised from the floor sufficiently to allow the right amount of air for cleaning purposes to flow into it. In the rectangular opening of the nozzle is a rubber comb which is pressed against the nap of the carpet by helical springs in such a manner that the dirt is stirred up and sucked into the dust bag which is attached to the handle of the apparatus. The suction fan consists of a cast-aluminum disk with projecting blades so constructed that lint and threads cannot become entangled in it. The fan is direct-connected to the shaft of a General Electric motor. In the aluminum casing surrounding the motor is an insulated bushing, through which runs a flexible cord connecting the motor with a switch located on the end of the handle where it can be operated by the palm of the hand. The wiring between the motor and the switch is run through a groove in the handle; between the motor and the point where the wire enters the groove is a separable plug coupling which makes it possible to disconnect the motor from the handle when desirable. A flexible cord, 20 ft. long, which is secured to the handle just below the switch, can be used to connect



ELECTRICALLY OPERATED VACUUM CLEANER

the vacuum cleaner with any electric-service receptacle. For cleaning draperies, walls, etc., it is only necessary to unscrew a cap on the front of the cleaner and fasten a hose onto the machine. The apparatus is compact and light, and is made in two sizes for use on direct or alternating current at 110 or 220 volts. One size of the machine is capable of delivering 140 cu. ft. of air per minute and the other size 95 cu. ft. of air per minute. The first weighs 10.75 lb. complete and consumes 140 watts, while the other weighs 9 lb. and consumes 125 watts. Both machines are so designed that they may be shoved under chairs, sofas, etc., in cleaning, the handle being adjustable to any angle.

Ornamental Electric Lamp Fixtures from Clay

Almost from the very beginning of electricity's service to man, clay in pottery form has been used as insulation for electrical energy. By adapting pottery to different styles of fixtures for diffusing the light of electric lamps, clay is now performing an additional function for illuminating purposes. These novel and ornamental fixtures have opened up a new line of possibilities to interior decorators. Of further interest is the fact that these lighting fixtures were brought out in this country and are now setting the styles in England, France and Germany, reversing the usual rule of originating fashions.

The designs were conceived and worked out in the oldest American pottery, which has been established and in continuous operation since 1805. The first half dozen such portable lamps made from pottery three years ago were shown in a private exhibition to connoisseurs in New York, and following their praise of the color combinations the manufacturer designed the present line of luminaries, including large and small portable lamps, chandeliers, shower lamps, wall lamps, solarium, ceiling and indirect-lighting units.

Among the beautiful glazes which are obtained in these ornamental fixtures are the mirrored flambe, luster, crystal and matte classes. The first four classes present mirror surfaces with varied tones and colors in combinations not unlike those seen in the sky at sunset. The matte class are glazes with a texture such as is revealed in the petals of flowers and the skin of fruit. The glazes are obtained by covering the dried clay pottery with a preparation and "firing" the design in a kiln at high temperature. Some glazes require a clear fire with plenty of oxygen to insure complete combustion, while others demand a smoky kiln, and still others an alteration of these fire qualities. Slow and fast cooling of the pottery after it has reached the proper temperature have varying effects on the glaze.

FIGS. 1 AND 2—PORTABLE LAMPS

FIGS. 3 AND 4—WALL LAMPS AND INDIRECT FIXTURE

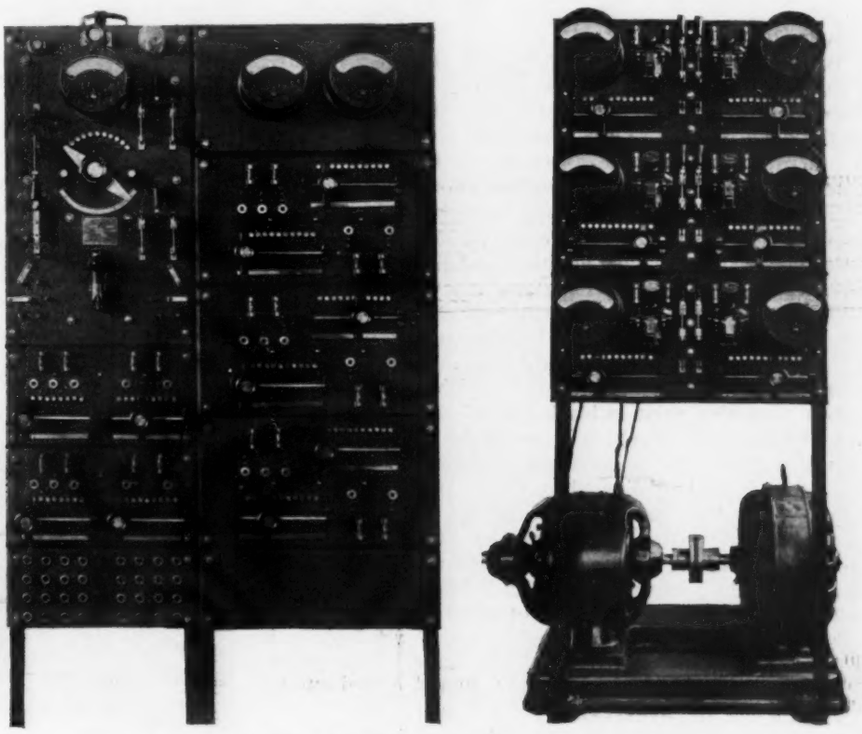
The four illustrations shown herewith convey some idea concerning the shapes and designs of the various types of fixtures. Fig. 1 shows a large portable lamp with a ring base, standing 19 in. in height. The shade is 17 in. in diameter and the fixture is finished with a matte glaze. The small portable lamp shown in Fig. 2 is 16 in. high, with a 9-in. shade, and is finished in the black and blue of the sky flambe. Figs. 3 and 4 show a group of wall lamps and an indirect fixture with a 17-in. bowl which is finished in a glaze of crystal blue.

The fixtures of pottery were developed and are being put on the market by the Fulper Pottery Company, Flemington, N. J.

Vehicle Battery-Charging Apparatus

At a recent meeting of the Chicago Section of the Electric Vehicle Association, Mr. J. P. Lyons, Chicago, described a new battery-charging equipment which the Electric Products Company, of Cleveland, Ohio, has just put on the market. The outfit, which is illustrated herewith, consists of a motor-generator set or rotary converter, a machine panel and a distributing panel. The number of distributing panels depends on the number of batteries to be charged. On the distributing panels are switches which automatically cut off the batteries as soon as they are charged and leave an indication showing a record of the condition. When the last battery is charged the switch cutting out the battery also operates the main-line switch on the alternating-current side of the rotary converter or motor-generator, as the case may be, thus eliminating the waste of energy which would result from allowing the rotary to run idle after all of the batteries are charged. The apparatus also disconnects the rotary when the alternating-current line is de-energized and starts the machine up again when service is restored. Practically no attention is required by the equipment.

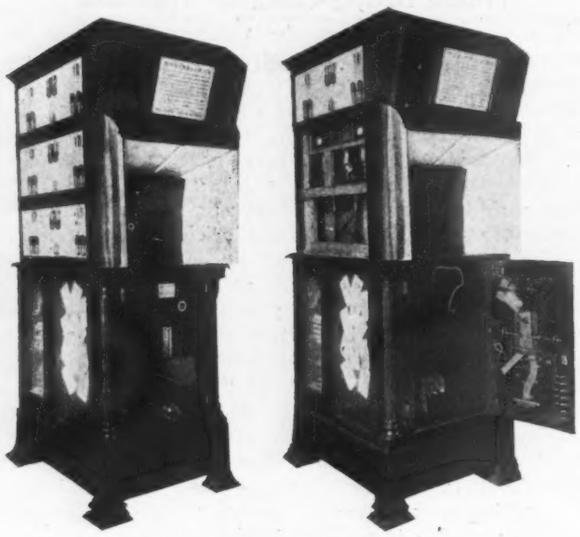
Another innovation in battery-charging apparatus described by Mr. Lyons is used in connection with an installation of mercury-vapor rectifiers or motor-generator sets supplying energy at different voltage. This consists of a transfer board by means of which 24-volt and 50-volt batteries can be grouped to the best advantage for charging, without wasting energy in rheostats. Some of these transfer boards together with the distributing boards have been installed in the Colonial Club Garage and in several private garages in Chicago.



FIGS. 1 AND 2—TRANSFER PANEL AND BATTERY-CHARGING INSTALLATION

Electrically Operated Slot-Machine Camera

A new electric photographic machine, which is entirely automatic in its action, has been invented and brought out in Paris by an engineer, Mr. H. Ashton-Wolff. The apparatus is coin-operated and takes an attractive platino-bromide portrait upon a postal card. A series of electric devices operated in an ingenious manner take the photograph and



SLOT-MACHINE CAMERA

put it through the various operations before delivering it in the finished state. Simple and reliable magnetic mechanism is used, there being no springs, cams or levers to cause complication.

When the customer inserts the coin in the slot an electric sign appears giving directions for the pose. A mirror finder enables the sitter to observe when he is in the center of the picture. During the brief time of exposure, which is practically instantaneous, a strong artificial light illuminates the person or object to be photographed. A signal indicates that the pose is finished, and the light is extinguished. The postal card is then put through the successive operations of developing, washing and drying by various electrical devices. After exposure, the card drops down into an ebonite dish or tank in which developing takes place. All solutions are stored in receptacles at the top and are fed through an electromagnetic valve and measurer combined, so that the amount used is invariable. The card develops a positive print in black and white by the use of a new chemical process which is one of the principal features of this device. The print is obtained by a single process and is ready to be delivered at once. It remains only to send a second or fixing bath into the tank through an electromagnetic valve, the first solution having been evacuated. The washing of the print by ordinary water is carried out in the same way. The dish into which all these baths flow then opens by means of electromagnets and the finished card drops into an electric drier, which dries it quickly but without softening the gelatine. The photograph is dried in fifteen seconds and is subsequently passed through a slot and delivered to the customer.

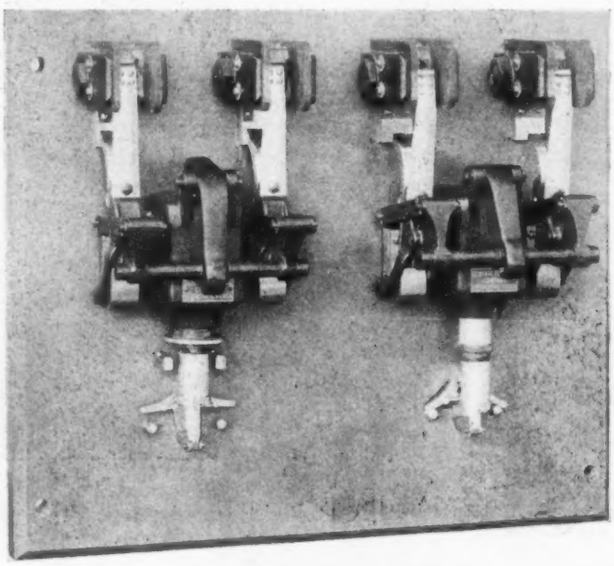
One of the interesting parts of the machine is a commutator for operating all the various circuits at the proper time, this distributer being a round disk on which are metal segments for the contacts. An arm carrying a certain number of brushes or contact pieces is passed over the disk so as to close the circuits in proper order. It is essential to avoid all sparking at the contacts, otherwise the commutator would rapidly burn out. This the inventor has overcome by using an outer circle with a series of strips which make contact with the arm before the latter leaves the main contacts. As the arm touches one of these points a small portion of the current is shunted into a solenoid, which consumes only 5 watts. This distant solenoid operates a metal point placed in mercury so that the current is broken here instead of on the commutator. The arm or lever makes one revolution covering all contacts needed for one photograph, and is driven by a small electric motor. The energy for operating this motor is received through the arm as it turns, and by means of specially devised resistors variations in speed are produced corresponding to the action going on at the precise moment. Such speeds can be set at will for any part of the machine by turning a small disk. In summer, for instance, when the heat makes the baths act more rapidly, the action of the chemicals can be shortened as may be required for good results and so left during the whole of the hot season.

The machine, it is said, will turn out 100 postal cards without any supervision or recharging, and the solutions will keep for one month at least. Each part of the machine is a separate device mounted on spring clip contacts so that it can be withdrawn instantly. In fact, the whole machine can be taken apart in this way without handling any wires. The refilling of the machine takes ten minutes.

Automatic Switching Apparatus

The maintenance of continuity of electric service to customers makes it imperative that means be provided for switching on reserve units instantly to supply energy in case of failure of the main source. The circuit-breaker shown in the illustration is designed for this type of service. It consists of two double-pole, single-coil, solenoid-operated, magnetic-blowout circuit-breakers, each of which remains closed only while the solenoid is energized. The circuit-breaker shown on the left is connected in the main supply circuit and, under normal operating conditions, is closed, the one on the right remaining open.

When the supply of energy from the main source fails



AUTOMATIC CIRCUIT-BREAKER BOARD

the circuit-breaker on the left opens and the metallic disk directly underneath this solenoid bridges the gap between the contact blocks below it. The action of this disk connects the operating coil of the circuit-breaker on the right across a storage battery or other source of energy. The operation of this breaker connects the feeder with the auxiliary source of energy, thus avoiding an interruption of

service. When the primary service is restored the solenoid of the circuit-breaker on the left is again energized, thereby causing the circuit-closing disk to be withdrawn from the contact blocks. This action breaks the circuit of the solenoid of the circuit-breaker on the right, cutting off the supply of energy from the auxiliary source.

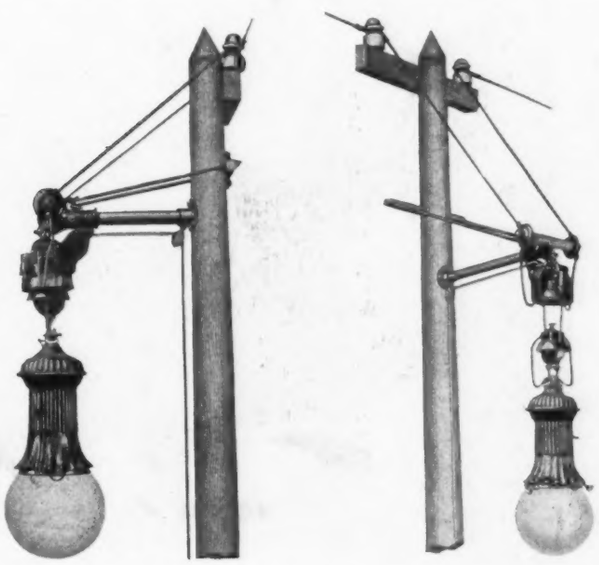
Each circuit-breaker is provided with a dash-pot and a set of auxiliary contacts, to which are connected the terminals of a resistor. The auxiliary contacts are bridged when the circuit-breaker is open. When the plunger in the dash-pot rises as the circuit-breaker closes, the bridge across the auxiliary contacts is removed, connecting the resistor in series with the operating coil. The resistor is not cut in, however, until the circuit-breaker is completely closed, because the dash-pot introduces a time interval between the closing of the circuit-breaker and the opening of the auxiliary contacts.

The switching apparatus described above is manufactured by the General Electric Company, Schenectady, N. Y.

Cut-Out Hanger for Arc Lamps

A simple and compact hanger to take the place of suspension equipment now used with series arc lamps has recently been put on the market by the Thompson Electric Company, Cleveland, Ohio. By means of this hanger the lowering of any lamp in a series lighting circuit automatically cuts the lamp out of circuit without disturbing the operation of the other lamps. All wiring is carried in straight lines from the poles to the hanger, thus saving a considerable amount of wire and averting trouble incident to hanging loops, which under present practice cause a good deal of the arc-lamp trouble. Again, since the lamp is detached from the circuit when lowered there is no danger from shock to the trimmer.

The illustrations Figs. 1 and 2 show the hanger with the lamp in the operating position and with the lamp slightly lowered and disconnected from the circuit. The lamp can be disconnected and lowered by pulling the lowering rope.



FIGS. 1 AND 2—HANGER IN TWO POSITIONS

As will be noted, the lamp is supported by a double-fall rope so that the trimmer in lowering the lamp handles only one-half its weight. The lowering rope is looped under and at right angles to all live parts and is kept far enough away from the current-carrying parts to provide a high insulation to ground. It is stated that these hangers have withstood an electrical potential of 23,000 volts and on a mechanical test have supported a weight of more than 1000 lb.

Fig. 3 shows details and a partial section of the hanger with the lamp in the operating position. Energy for operating the lamp enters through the bar *A*, passes through catch *C*, then through the lamp, returning through parts *D* and *B* consecutively. Insulation between *C* and *D* prevents

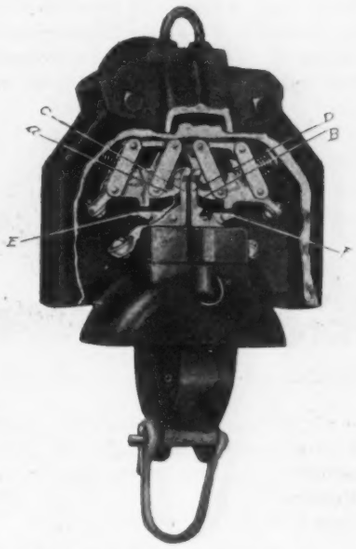


FIG. 3—DETAIL AND PARTIAL SECTION OF HANGER

any arcing at this point. The letters *E* and *F* indicate pawls which hold the catches apart while the lamp is being lowered. The contacts are arranged to "wipe in" so that they will remain bright and clean.

Although the illustrations herewith show the hangers installed only from mast arms, they are also made in styles permitting their use on span wires.

Trackless Trolley Bus

The Field Electric Bus Company, of 135 Broadway, New York City, is now manufacturing electric buses of two types. One type of bus is equipped with Edison storage batteries and the other type, described in the *Electrical World* of June 14, 1913, is supplied with electrical energy from overhead trolley wires. The latter type does not carry storage-battery equipment.

An Improved Insulating Material

A new insulating material known as "micarta" and intended to take the place of hard fiber glass, porcelain, hard rubber, built-up mica, pressboard, rawhide, molded compounds and the like has been developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

This insulating material is used for commutator bushings and brush-holder insulation, for noiseless gear blanks, for conduit for automobile wiring, for spools for spark-coil and magnet windings, for refillable fuse tubes, for "wireless" coil separators, for arc shields in circuit-breakers, for water-meter disks and for other purposes.

Micarta is a tan-brown, hard, homogeneous material having a mechanical strength about 50 per cent greater than hard fiber. It can readily be sawed, milled, turned, tapped or threaded, if a sharp-pointed tool is used and the work done on a lathe. It can be punched only in thin sheets and cannot be molded. Micarta is not brittle, and it is claimed that it will not warp, expand or shrink with age or expo-

sure to the weather. The finished product takes a high polish, presenting a neat appearance.

Two grades of the material are made. That known as "bakelite micarta" will stand a temperature of 150 deg. C. (300 deg. Fahr.) continuously or 260 deg. C. (500 deg. Fahr.) for a short time. It is infusible and will remain unaffected by heat until a temperature sufficient to carbonize it is reached. It is said that bakelite micarta will stand an electric arc better than hard fiber, hard rubber, built-up mica or any molded insulation containing fibrous or resinous materials. The coefficient of expansion of this product is low, being approximately 0.00002 in. per deg. C.

FIG. 1—INSULATING MATERIAL IN SEVERAL SHAPES

This grade of the insulation is insoluble in practically all of the ordinary solvents such as alcohol, benzine, turpentine and weak solutions of acids and alkalis, hot water and oils. It is indifferent to ozone, which is an advantage over hard rubber, resins and the like when used for electrical purposes. It is non-hydroscopic and is impervious to moisture.

The other grade, designated as No. 53 micarta, has the same mechanical and electrical properties as bakelite micarta but differs in its chemical and thermal properties. The plain micarta behaves toward chemicals and heat very much as an ordinary resin. This grade is not used in plate form.

As proof of the uniformity of structure of bakelite micarta, the accompanying illustration of a fracture is shown. The tube was held tightly on a metal mandrel and a compressive force was applied at one end of the tube. When the force became sufficiently great the tube split as shown. The uniformity of the wavy fracture proves the homogeneous structure of the material. Such a break is known as a harmonic fracture. The strains in a homogeneous

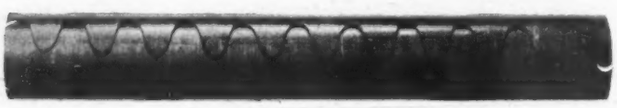


FIG. 2—A FRACTURE IN MICARTA

material under stress follow a sine wave law. If one part of the material is weaker than the rest, the strain at this point becomes greater and the harmonic wave is distorted. However, it will be seen from the illustration that the strain closely followed the true harmonic wave, indicating that every part of the material was as strong as any other part.

Pole-Type Voltage Regulator

Formerly the apparatus for voltage regulation has been limited to the indoor type and installation at remote points would have necessitated building substations which in many cases would have made the expense of installation prohibitive.

The General Electric Company has placed on the market an automatic voltage regulator for outdoor service which has been arranged so that it can be installed on a pole or in any other convenient place. This regulator is designed for single-phase, 60-cycle circuits and will regulate the voltage within 10 per cent above or below normal if the power which is carried by the circuit does not exceed 25 kva.

The regulator, which is of the induction type, has two windings arranged on separate iron cores, the primary or shunt winding being connected directly across the circuit and the secondary winding connected in series with the line.

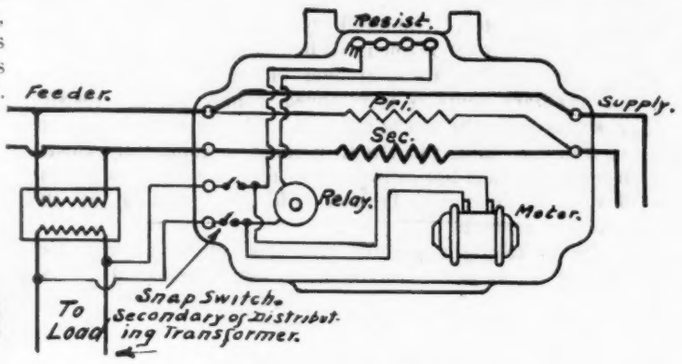


FIG. 1—DIAGRAM OF CONNECTIONS

The primary core with its winding is constructed so that it can be rotated within the core of the secondary or stationary coil. In this manner the effect of its flux upon the secondary coil may be varied, causing the voltage of the feeder to be increased or decreased.

Movement of the rotor is effected by means of a small single-phase motor which runs continuously. Normally this motor is mechanically disconnected from the rotor, and connection therewith is controlled by a voltage relay the winding of which is energized from the regulated side of the feeder.

A device provided for limiting the movement of the rotor consists of two cams mounted on a common arm turning on the shaft of the ratchet wheel. When the limit of

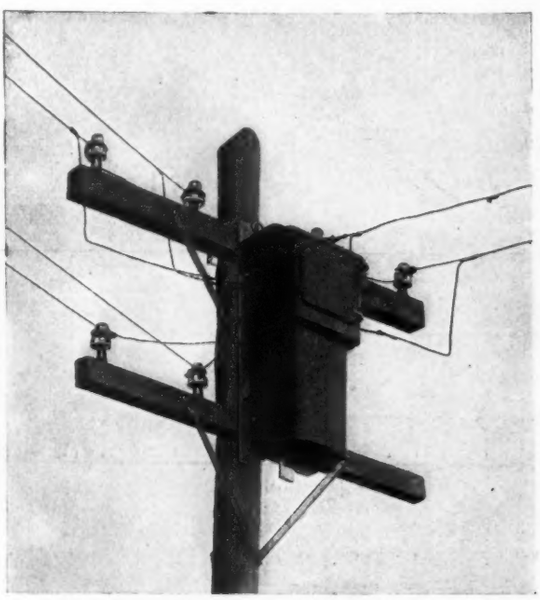


FIG. 2—VOLTAGE REGULATOR INSTALLED ON POLE

travel is reached a cam is moved up beneath the pawl and prevents it from engaging with the ratchet wheel. All parts of the regulator are inclosed in a dust-proof and rain-proof tank. The core and coils are located in the lower part of the tank and immersed in oil. A door provided in the upper part of the tank allows access to the mechanism for adjustment and oiling.

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

Lighting Contract Awarded.—The Engberg's Electric & Mechanical Works, St. Joseph, Mich., has secured the contract for the electrical equipment of the Citronelle Light, Ice & Power Company, Citronelle, Ala., including one 55-kva single-phase alternator and a 12-ft. by 10-ft. engine, with switchboard complete. References to this plant appeared in our issues of May 10 and June 21.

New Power House for Pennsylvania State Hospital.—Of the appropriation of $195,000 recently made by the Legislature of Pennsylvania for improvements to the state hospital at North Warren, Pa., $125,000 will be expended for the construction and equipment of a new power house. The building will be of pressed brick and stone and attractive in appearance. Automatic stokers will be used in the boiler room, and patent smoke consumers will be installed.

Isolated Plants to Be Installed.—Charles E. Knox, consulting engineer, 101 Park Avenue, New York, is now working on the design of a 700-kw installation with elevators and wiring for the Hallenbeck-Hungerford building, at Lafayette Place and White Street, New York. He is also designing a 1000-kw plant with motor-drive equipment, elevators and wiring at St. John, N. B. In neither of these cases has the contract been let for the apparatus or materials.

Canadian Underground Cable Installation.—G. M. Gest, of Montreal and New York, has been awarded the contract for constructing a system of underground conduits for the town of Outremont, Quebec. A twin system will be built, one set being used by the town for the distribution of light and power in the future, and the other set by the Bell Telephone Company. Mr. Gest has undertaken to construct the conduits in 250 good working days. Altogether five tenders were sent in for the work.

Street-Lighting Activity in Canada and in Texas.—A local concern in the lighting-pole business has recently received an order for sixty combination luminous-arc and trolley poles for use on one of the main thoroughfares of Galveston, Tex. The same company states that in Canada there is particular activity in these lines. It has just supplied to the city of Peterborough, Ont., 100 poles of the same type as above noted and has negotiations in progress with several other Canadian cities for the supplying of ornamental poles for street lighting.

Cedar Rapids Power Development Progressing Rapidly.—From Mr. George C. Clarke, chief engineer for Fraser, Brace & Company, 1328 Broadway, New York, it is learned that rapid progress is being made on the hydroelectric development for the Cedar Rapids Manufacturing & Power Company, at Montreal, Can. At present there are six shovels busy on the job and concrete work on the power house foundations will be started during July. It is expected that the first units will be installed toward the latter part of October. About 100,000 kw will be available when the present plant is completed, and a reserve capacity of 50,000 kw will be left for future development.

Kerr Turbine Business Excellent.—The Kerr Turbine Company, of Wellsville, N. Y., is experiencing the largest volume of business in its history. Export orders have been received recently from England, India and the Sandwich Islands. The company has developed a 500-kw alternating-current unit for which it is expected there will be a large demand. In the shops at this time there are seventy-two turbines building, which will aggregate about 10,000 hp, and an order has just been placed by one of the large pump manufacturers for sixteen Kerr turbines. Among the recent shipments of "Economy" turbines the following are the more important: Four 800-hp turbines for driving 25,000,000-gal. pumps, Chicago Water Works; an 850-hp turbine for similar service at Nashville, Tenn.; two 100-kw and two 150-kw turbo-generator sets for the Republic Coal Company, Roundup, Mont.; two 35-kw generator sets for the steamship *Washington Irving;* three 75-kw sets for the new steamship *Seeandbee* for Great Lakes service; four turbo-pump units for Swift & Company; two for the Detroit General Hospital; two for the Pittsburgh Crucible Steel Company, and two for the Carnegie Steel Company.

Texas & Pacific Railway's New Orleans Terminal.—Arrangements have been completed for the construction of a large terminal station for the Texas & Pacific Railway Company at New Orleans, La., and it is expected that actual construction will begin shortly. Besides the building of the station proper, there is extensive grading work to be done, and the tracks are to be shifted to some extent. One of the company officials placed an estimate of $5,000,000 as approximately the cost of the entire project. Extensive electrical equipment will be installed, but no data are at present available on this point. The architects are Messrs. Favrot & Livaudais, of New Orleans.

New Electric Car Models for 1914.—The Anderson Electric Car Company, of Broadway and Eightieth Street, New York, which handles the Detroit electric line of pleasure cars and trucks, announces that several new models are to be put out in 1914, S. W. Menefee being in Detroit this week inspecting them. A new limousine designed especially for the New York trade is among the offerings for the coming year, which include also a forward-drive car which can be operated from either the front or the rear seat. The storage-battery equipment for these cars is supplied by the Edison Storage Battery Company, of Orange, N. J. The new models are scheduled to appear about Sept. 15.

Canadian Engineering Concern Reorganized.—Under the reorganization of the business of W. N. Dietrich, electrical and mechanical engineer, Montreal, Quebec, the scope of the undertaking has been enlarged. The company is known as Dietrich, Limited, and undertakes conduit installations, transmission lines and power plants and heating. The president is W. N. Dietrich, who was formerly electrical engineer for the Canadian Pacific Railway Company's entire system, while the vice-president is G. E. Templeman, previously superintendent of construction in the engineering department of Allis-Chalmers-Bullock, Ltd. The company is now doing extensive electrical work in the provinces of Quebec and Ontario.

Big Asbestos Company Adding to Its Equipment.—The H. W. Johns-Manville Company, Forty-first Street and Madison Avenue, New York, is enjoying in nearly all of the lines handled by it very good sales, and in its line of refrigerating machines its production department is having trouble keeping pace with the sales department. In order to take care of the increasing demand extensive building operations have been necessary. At Manville, N. J., an immense factory is in process of construction which will when completed add materially to the manufacturing facilities of the company. Two large three-phase, 60-cycle Curtis turbo-generators of General Electric make are to be installed at this plant, together with three exciter sets. A Westinghouse-Leblanc condenser and six 500-hp Babcock & Wilcox boilers will form part of the equipment also. An aggregate of 2800 hp of Westinghouse motors at ratings from 150 hp down will be installed for drive purposes. There are seven buildings in the group at Manville. The generating equipment is in a building by itself and the layout has been planned to allow for a future development of 5000 kw additional. The wiring is all underground there.

At the Canadian plant alterations are being made and the crushing equipment is being increased. At the plant of the Asbestos Shingle Company, Riverdale, Ill., 500 hp in General Electric and Westinghouse alternating-current motors is being installed. This concern, which is a subsidiary company, draws its energy from the lines of the Illinois Traction Company.

Dominion Power & Transmission Company Adding to Its Generating Equipment.—The Dominion Power & Transmission Company has made some large extensions during the year. Two large turbine units have been provided for its Decew Falls generating plant, while the expansion of the Steel Company of Canada at its Hamilton plant adds a very large consumer. An additional transmission line from Decew Falls to Hamilton is also among the proposed extensions. This company is contemplating building a million-dollar steam auxiliary plant. The presence of needle ice at Decew Falls in the winter, resulting in a temporary shutting down of the generators, has induced the company to guard against similar occurrences by making its steam auxiliary capable of producing 30,000 hp—sufficient to meet the demands of the present.

Detroit Edison Company Optimistic on Present Industrial Condition.—Speaking of Detroit's industrial condition, Alexander Dow, president of the Detroit Edison Company, said recently: "Our output to factories shows no falling off in the volume of demands for power. It is true a few factories are being closed just now for the usual summer inventory, but the day load carried by our plant shows no reduction. In fact, the load is more than 30 per cent greater than it was last year at this time." The Detroit Edison Company has just sold to Spencer Trask & Company, of New York, $1,000,000 of first mortgage 5 per cent gold bonds at par. Funds derived from the sale of the bonds will be employed in meeting part of the expense of constructing and equipping the mammoth new East Side power plant on which the Detroit Edison Company has commenced work.

Turbo-Alternator Installation for an Illinois Factory.—An isolated generating plant is being constructed by the Whitman & Barnes Manufacturing Company, of Chicago, at its factory in West Pullman, Ill. A 1150-kva turbo-alternator is to be installed which will furnish energy for the operation of about 1200 hp in motors. This company manufactures machinists' supplies and agricultural implements and the plant covers a ground area of 1400 ft. by 600 ft. As the buildings which constitute the factory lie in a continuous row, a cable duct 1350 ft. long will be constructed beneath the buildings, in which two sets of three-phase feeder cables will be laid. Each cable contains three conductors having 350,000 circ. mils cross-section. The motors will be operated on 440 volts. The wiring for the new layout is being done by the Freeman-Sweet Company of Chicago.

Westinghouse Financing.—The Westinghouse Electric & Manufacturing Company has sold to Kuhn, Loeb & Company a new issue of $3,250,000 two-year 6 per cent collateral notes due Aug. 1, 1915. The proceeds will be used to pay off $4,000,000 three-year 6 per cent collateral notes due Aug. 1, 1913, $750,000 being supplied in addition from the surplus treasury funds of the company. A premium of $10 in cash is being offered by the bankers for each thousand-dollar note exchanged for the newer securities, the collateral back of which must have a market value 50 per cent in excess of the value of the notes outstanding and the income from which must exceed the interest on the securities. The business of the Westinghouse Electric & Manufacturing Company thus far this year has exceeded that of any other period in the history of the company, and it is certainly gratifying to note that in refunding a maturing issue of securities the company has actually decreased the amount issued.

Expansion of the Utah Securities Corporation.—A short time back seventeen hydroelectric properties in Idaho, Utah and Colorado were consolidated under the name of the Utah Securities Corporation, and at the time of the merger the aggregate capacity of the several plants was in the neighborhood of 56,700 hp. Since the consolidation three additional properties, with a total of 18,100 hp, have been acquired by the corporation. There is now under construction at Grace, Idaho, a 29,250-hp addition which will be completed early in 1914. At Oneida, Idaho, a new development is projected which will have an initial capacity of 27,000 hp and will be completed in the latter part of the same year. The corporation is operating at present about 1454 miles of transmission and distributing lines and has now under construction a 130,000-volt steel tower line, 135 miles long, between the above-mentioned plants and about 147 miles of high-tension transmission lines in other sections. Electric energy from these lines is used for street-railway, irrigation, pumping and mining operations as well as for lighting and electric drive.

Local Installations of Semi-Indirect Fixtures.—The Lighting Studios Company, of 16 East Thirty-third Street, New York, has recently completed the installation of about 1500 semi-indirect lighting fixtures in the Forty-second Street Building, at Forty-second Street and Madison Avenue, and of between 600 and 700 similar type fixtures in the Associated Architects' Building, 101 Park Avenue, New York. In both cases their Doric moonstone hemispheres were used. The first-named building is twenty-four stories high, and the floor plans from the third to the twenty-third floors inclusive are similar. In the largtr offices there were placed two 14-in. globes each containing two 150-watt tungsten lamps, and in the smaller offices a single 12-in. globe with a 250-watt lamp was found adequate. It is notable that this building was planned for direct lighting, and the decision to install the semi-indirect system was made at the last moment, after it had been proved that the latter would be the more economical. An important objection to its adoption was the fact that it practically precludes the use of desk lights, since the outlets are rather inaccessible, but this disadvantage was more than offset by the economies obtained, and it is claimed that the desk lights are not required where the semi-indirect system is in use.

Westinghouse, Church, Kerr & Company Doing Varied Work.—Under the leadership of John F. Wallace, formerly chief engineer of the Panama Canal, Westinghouse, Church, Kerr & Company, who are now fairly well settled in their new quarters at 37 Wall Street, New York, are taking up a varied line of work, well scattered over the country, that promises to keep busy their large and able corps of engineers. For the British Columbia Electric Railway Company, of Vancouver, B. C., considerable work is in progress. Shops are to be designed and built at Barnaby, B. C., including accommodations for all the construction and repair departments. Electric drive will be used largely in these buildings and they will be lighted electrically, but the contracts for these parts of the equipment have not yet been let. For the same company there are to be constructed carhouses and shops at Vancouver, North Vancouver and Victoria, B. C. At the Hotel Nassau, Long Beach, N. Y., the machinery is being overhauled, together with the kitchen, sanitary and refrigerating equipment. A boiler plant is being built for Cluett, Peabody & Company, Troy, N. Y., in which will be installed two 300-hp horizontal-return tubular boilers of D. M. Dillon make. From plans prepared by the A. B. Baxter Engineering & Appraisal Company, of Buffalo, N. Y., a foundry is under construction for the Northwestern Brass Company at Calgary, Alta. For the American Cyanamid Company, of Niagara Falls, N. Y., a number of buildings are being designed, erected and equipped with plumbing and heating systems, conveyors and electrical apparatus. Energy for this development will be taken from the 12,000-volt, three-phase, 25-cycle lines of the Ontario Power Company, and four of these high-tension lines will enter the plant. The necessary complement of oil switches and lightning arresters will be provided on the high-tension side and also a control board for the low-tension side. Three 800-kva oil-insulated, water-cooled transformers, 11,700/46 volts, delta to star-connected, will form the bank feeding each carbide furnace, and there will be four such banks. Three transformers of similar type, rated at 375 kva, 11,700/75 volts, and delta to delta-connected, will feed 216 cyanamide ovens. Again, three of the same type of transformers, wired for 11,700/440 volts, will supply the service energy for electric drive and lighting. It is understood that as yet none of the electrical equipment has been ordered.

Statement of the Copper Producers' Association for June

The June figures on copper production and consumption in this country show some marked variations from the figures for May, as shown below:

	June, pounds		May, pounds	
Stocks on hand in the United States on first of month		67,474,225		75,549,108
Production		121,860,853		141,319,416
		189,335,078		216,868,524
Domestic deliveries	68,362,571		81,108,321	
Foreign deliveries	68,067,901		68,285,978	
		136,430,472		149,394,299
Stocks on hand at end of month		52,904,606		67,474,225

Industrial Securities

Security	Capital Stock Listed	DIVIDEND		QUOTATION	
		Per Cent	Period	July 1	July 9
Allis-Chalmers, t.r., 5th pd	$19,800,000	.....	.....	6½*	5¾
Allis-Chal., pf.,t.r.,5th pd	16,050,000	.....	.....	14	14*
Amalgamated Copper	153,887,900	1½	Q	65⅜	63⅜
American Tel. & Tel.	344,471,400	2	Q	127½	126⅜
Electric Storage Battery,c.	16,074,425	1	Q	46½	45½
General Electric	101,363,600	2	Q	135½	137
Mackay Cos., c	41,380,400	1½	Q	89*	89*
Mackay Cos., pf	50,000,000	1	Q	68*	68*
Western Union Tel.	99,747,600	¾	Q	62	60
Westinghouse, E. & M., c.	34,496,400	1	Q	58¾*	57
Westinghouse, E. & M., pf.	3,998,700	1¾	Q	109*	109*

*Last price quoted.

NEW YORK METAL MARKET PRICES

	June 30 Bid.	June 30 Asked.	July 8 Bid.	July 8 Asked.
Copper:				
Standard, spot	13.87½	.....	13.75	to 14.30
	£ s d		£ s d	
London, standard, spot	64 2 6		63 3 9	
Prime Lake	....	14.87½	14.75	to 14.85
Electrolytic	14.50	to 14.62½	14.50	to 14.60
Casting	14.37½	to 14.50	14.35	to 14.40
Copper wire base	15.75	to 16.00	.....	15.75
Lead		4.35		4.35
Nickel	40.00	to 45.00	40.00	to 45.00
Sheet zinc, f. o. b. smelter		7.00		7.00
Spelter, spot	5.30	to 5.35	5.40	to 5.50
Tin, spot	42.50	to 42.75	39.20	to 39.50
Aluminum:				
Prompt delivery	23.00	to 24.00	23.00	to 24.00
Future	22.00	to 23.00	22.00	to 23.00

OLD METALS

Heavy copper and wire	13.50	13.25
Brass, heavy	8.75	8.12½
Brass, light	7.75	7.25
Lead, heavy	4.25	4.25
Zinc, scrap	4.12½	4.37½

COPPER EXPORTS

Total tons to July 8 3,751

Business Notes

W. Edgar Reed, consulting engineer, whose office was formerly in the Machinery Building, Pittsburgh, Pa., has moved to the Frick Annex in the same city.

The Lansden Company, until recently located at Newark, N. J., has changed its headquarters to Allentown, Pa. The company is a large maker of commercial electric vehicles and is preparing to finance an expansion in this line.

The Industrial Instrument Company, of Foxboro, Mass., is experiencing a large demand for its Foxboro improved recording gage designed with a siphon gage for measuring low ranges of pressure. A two-page illustrated leaflet describing this apparatus has recently been put out.

The Shaefer-Frenzel Company, of Detroit, has opened offices on the sixteenth floor of the new Dime Savings Bank Building. Joseph E. Shaefer, president, was formerly in the spark-plug business; H. Ray Haberkorn, vice-president, is a large contractor, and Arthur W. Frenzel, secretary-treasurer, was formerly with the Disco Electric Starter Company.

C. H. Vom Bauer, formerly with the American Electric Furnace Company, has recently been engaged as engineering salesman by Halbert P. Hill, Inc., 30 Church Street, New York. The latter concern has been appointed Eastern agent for the Electric Machinery Company, of Minneapolis, Minn., and Mr. Von Baur will have charge of this end of the business.

New Industrial Companies

The United Pump & Power Company, of Chicago, has been incorporated at Chicago with a capital of $100,000. G. E. Lemon, 126 Liberty Street, New York, is one of the incorporators.

The D. & R. Storage Battery Company has been incorporated with a capital of $100,000. A. R. Lucker, J. E. Reid and Rudolph Drambourgh, 969 Kent Avenue, Brooklyn, N. Y., incorporators.

The Steinbock Engineering Company has been incorporated in New York to manufacture explosive motors for autos, with a capital of $250,000. Incorporators: H. E. Steinbock, Frank C. Sievers and A. R. Gormully, New York.

The Steel City Electric Company, of Pittsburgh, Pa., has been incorporated to manufacture and deal in electrical and mechanical devices, with a capital of $5,000. Horace S. Gould, 37 Wall Street, New York, is one of the incorporators.

Trade Publications

"Adaptiboxes."—A leaflet issued by the Adapti Manufacturing Company, Cleveland, Ohio, gives a few reasons why "adaptiboxes" should be used.

Rectifiers.—A miniature of the regular 8 in. by 10.5-in. bulletin of the Wagner Electric Manufacturing Company, St. Louis, Mo., is being mailed. It refers to the Wagner alternating-current rectifier and is known as Bulletin No. 100.

Fans.—Westinghouse electric fans, alternating-current, are made the subject of a twenty-page booklet recently distributed by the Westinghouse Electric & Manufacturing Company. Desk and bracket fans, residence fans, oscillating fans, telephone booth fans, ceiling and column fans, as well as exhaust fans are all illustrated.

Terminals.—Bulletin No. 700-1 of the Standard Underground Cable Company, Pittsburgh, Pa., refers to its D. O. A. type of outdoor cable terminals. In its twenty-eight pages are contained illustrated descriptive matter, tables of dimensions, voltages, weights and instructions for installing outdoor cable terminals. This bulletin is the first of a new series that is to supplement other literature.

Generating Sets.—The generating sets made by the Engsberg's Electrical & Mechanical Works, St. Joseph, Mich., are the subject of many testimonial letters which have been assembled in a thirty-six-page booklet recently issued by the company. The Engsberg company makes generators and vertical-type engines of from 2.5 kw to 50 kw, which are especially adapted for small electric-light plants.

Steel-Armored Hose.—Catalog No. 521, issued by the Sprague Electric Company, New York, is devoted to its flexible steel-armored hose for railroad service. This material consists of a rubber hose completely covered with an interlocking galvanized steel armor, designed to offer extremely high resistance against external forces or internal pressure. Its use in railway work is described and illustrated.

Electric Vacuum Cleaners.—The Hurley Machine Company, Clinton and Monroe Streets, Chicago, has issued a folder referring to the Hurley "Six" and Hurley "Four" electric vacuum cleaners, two of its latest products. A special feature of this apparatus is the nozzle specially designed to pick up threads and ravelings. Every machine is complete with electric cord, switch, etc., mounted in the handle. It is only necessary to slip the two connectors (located at the lower end of the handle) together, and it is ready for operation.

GRIPPER AND SLIDE GUIDE

Personal Mention

Mr. H. C. Case, formerly of Philadelphia, has been elected general superintendent of the St. Petersburg (Fla.) Investment Company, which supplies electric service at St. Petersburgh and Gulfport.

Mr. Henry L. Angloch has been appointed superintendent of the Bureau of Electricity, Pittsburgh, to fill the vacancy caused by the death of Mr. Robert J. Daley, whose assistant he had been for nine years.

Mr. C. A. Brant, formerly of the Public Service Corporation of New Jersey, has been appointed secretary and general manager of the Toms River & Island Heights Electric Light & Power Company, Toms River, N. J.

Mr. C. J. Pleming has been elected secretary-treasurer of the Knoxville (Tenn.) Railway & Light Company as successor to the late Leon Fender. Mr. Pleming has been connected with the company for nearly nine years, beginning as private secretary to the president of the company, Mr. C. H. Harvey.

Mr. C. A. Whipple has been elected general superintendent of the municipal light and water system of Eugene, Ore., as successor to Mr. A. Meyers, who resigned July 1. Mr. Whipple, who is a graduate of the University of Washington and Cornell University, was formerly connected with the municipal system of Seattle, with the Puyallup development of Stone & Webster, with the Vancouver Power Company and with the Mount Hood Railway, Light & Power Company, of Portland, Ore. Up to the time of his election as general superintendent of the Eugene municipal plant Mr. Whipple was assistant electrical engineer of the Portland, Eugene & Eastern branch of the Southern Pacific Railroad.

Mr. John F. Wallace, president of the engineering firm of Westinghouse, Church, Kerr & Company, of New York, has been selected as the engineering adviser of the Chicago City Council committee on railroad terminals. Mr. Wallace will be required to make a report on the entire railroad-terminal situation in Chicago relating both to freight and passenger traffic. Mr. Wallace, one of the leading engineers of the country, was for some time a vice-president of the Illinois Central Railroad Company in Chicago, and at one time was chief engineer in charge of the Panama Canal operations. Not long ago his firm compiled a report in relation to the terminal facilities of the western Indiana group of railroads in Chicago. He is a past-president of the American Society of Civil Engineers.

Dr. W. F. M. Goss, dean of the College of Engineering of the University of Illinois, has been appointed chief engineer for the Chicago Association of Commerce committee on smoke nuisance and electrification of railroad terminals in Chicago. Dean Goss succeeds in this position the late Horace G. Burt. He has received a year's leave of absence from the university. He was chosen unanimously by the committee, of which he has been a member from the start. Dr. Goss was born in Massachusetts in 1858, and obtained his technical education at the Massachusetts Institute of Technology. For seventeen years he was a member of the faculty of Purdue University, being dean of the engineering school for a large portion of that time. Since 1907 he has been dean of the College of Engineering at the University of Illinois. The report of the Chicago Association of Commerce committee, which will be very elaborate, is expected to be made public before July 1, 1914.

Dr. William McClellan, who resigned a short time ago as chief and engineer of the division of light, heat and power of the Public Service Commission of the Second District, New York, has been retained as assistant to the president of the Buffalo General Electric Company, Buffalo, N. Y. Dr. McClellan was educated at the University of Pennsylvania and is a member of the council of the University of Pennsylvania Club of New York City and president of the Associated Pennsylvania Clubs, an organization of the alumni associations of the University of Pennsylvania in all parts of the world. He is a member of the Railroad Club of New York, the Engineers' Club of New York City and the University Club of Albany. He is a fellow and manager of the American Institute of Electrical Engineers and a member of the American Society of Mechanical Engineers. He is a director of the Automatic Train Stop Company and of the Campion McClellan Company, engineers and constructors, with offices at Philadelphia. Dr. McClellan will maintain offices at 141 Broadway, New York City, to assist in the operation and management of public-service properties.

Mr. Charles O. Bond, president-elect of the Illuminating Engineering Society, was born Nov. 15, 1870, near the town of Lehigh, Webster County, Ia. After graduation from the United States Naval Academy, Annapolis, Md., in 1890, he served one year at sea on board the U. S. S. *Enterprise* and U. S. S. *Philadelphia*. He later taught school in the States of Iowa and New York for five years, and in 1897 became connected with the United Gas Improvement Company in Philadelphia. In 1898, during the Spanish-American War, he served five months as an ensign in the navy on board the U. S. S. *Lancaster* and the U. S. S. *Newport*. At the close of the war he resumed his connection with the United Gas Improvement Company, taking charge of the photometric work of the company. While continuing in this position, he also held command of one division of the Naval Force of Pennsylvania for three years. Since 1909 Mr. Bond has been manager of the photometrical laboratory of the United Gas Improvement Company, which was established in that year. Mr. Bond was a charter member of the Illuminating Engineering Society and has served one term as a director and one term as a vice-president. He is also a member of the (British) Illuminating Engineering Society, the American Gas Institute, the National Commercial Gas Association and the Franklin Institute. He was an American delegate to the International Photometric Commission in Zurich in 1911.

CHARLES O. BOND

Mr. Joseph D. Israel, who has twice been elected general secretary of the Illuminating Engineering Society, has been connected with the lighting industry during the past twenty-six years. He is at present district manager of the Philadelphia Electric Company. Mr. Israel was born in Philadelphia, Feb. 28, 1868. In 1886 he was graduated from the Scientific School of the University of Pennsylvania with the degree of bachelor of science. After a post-graduate year in mechanical and electrical courses, the same university conferred upon him the degree of mechanical engineer in 1887. Immediately after graduation he became connected with the Edison Electric Light Company of Philadelphia, devoting his time to the underground street work. Shortly afterward he became superintendent of the street work of the company. He next became assistant to the manager of the company and later was made secretary and manager. When the company was merged with the Philadelphia Electric Company he became district manager of the latter company. Mr. Israel has been active in the local and national work of the Illuminating Engineering Society, the National Electric Light Association and the American Institute of Electrical Engineers. He is a member of the Franklin Institute and a director of the Commercial Section of the National Electric Light Association. He has contributed papers and reports to local and national meetings of the above-named societies and the Association of Edison Illuminating Companies.

JOSEPH D. ISRAEL

Construction

New England

WATERVILLE, ME.—The Central Maine Pwr. Co. is planning to erect 10 miles of 33,000-volt transmission line between Winslow and Shawmut, this being a line parallel with the present one. The material has already been purchased. H. W. Eells, general superintendent.

WARREN, N. H.—A fire caused by sparks from a passing engine resulted in the almost total destruction of the plant of the Warren Wtr. & Lt. Co. E. E. Carby, manager.

FITCHBURG, MASS.—John F. Malley and others have petitioned the City Council for a cluster lighting system from Summer to Water Street, to include Harvard Street as far as the Viaduct and Fifth to Water Street.

HOLYOKE, MASS.—Within the next two months the municipal gas and electric-light plant expects to purchase distribution cable for underground work. The conduits are now being laid, but the contract for the cable has not yet been awarded. John J. Kirkpatrick, manager city of Holyoke Gas and Electric Department.

HUDSON, MASS.—The municipal electric light and power plant has recently purchased one 250-kva, three-phase 60-cycle, 3600 r.p.m. turbo-generator. Within the next two months it is planned to purchase a condenser to be used with the above equipment. Geo. A. Brothers, manager.

MILFORD, MASS.—It is reported that about $9,000 will be spent on improvements to the plant of the Milford El. Lt. & Pwr. Co.

WORCESTER, MASS.—The Worcester Merchants' Association, through Mr. J. E. Bradley, president of the Osgood-Bradley Car Co., recently petitioned the Mayor to install an ornamental lighting system on the ground that it will boom Worcester.

STAMFORD, CONN.—The Stamford Gas & El. Co. has recently purchased a 2500-kw Westinghouse 2300-volt, three-phase turbine and one 650-hp B. & W. boiler for 200-lb. pressure and 150 deg. superheat; also a switchboard panel. G. B. Leland, superintendent.

Middle Atlantic

DUNKIRK, N. Y.—The board of water commissioners is planning to purchase within the next two months a 400-hp horizontal water-tube boiler for the municipal lighting plant. B. C. Candee, superintendent.

GENESEO, N. Y.—The Geneseo Gas Lt. Co. expects to replace the present street-lighting system with a modern one. The company has not yet decided whether it will continue to supply energy from its own plant or to purchase it from another source. T. W. Landon, superintendent.

GREENWICH, N. Y.—The Booster Club is planning a special meeting at which a movement will be agitated for the installation of electric lighting throughout the town, which is situated near Glens Falls.

PRATTSBURG, N. Y.—At a special election held recently the proposition to light the village by electricity was carried by a majority of 39 votes. The work of installing the plan will soon commence.

PHILADELPHIA, PA.—The United El. Constr. Co. has been awarded the contract for the electrical equipment for the dispensary building to be erected for the American Viscose Co. at Marcus Hook, Pa., also the contract for similar equipment for the Villa Maria Academy, at Frazer, Pa., at a cost of $25,000.

ATLANTIC CITY, N. J.—The proposition of the Atlantic City El. Co. to place the wires along the ocean front under the Boardwalk has been received favorably by the Ventnor Council. It is proposed to install hollow iron standards 10 ft. in height and 12 in. in diameter at the base, the cost of which would be about $25 each.

TOMS RIVER, N. J.—In anticipation of the increased demand for energy the Toms River & Island Heights El. Lt. & Pwr. Co. will within the next two months erect an addition to its power house. The company has recently purchased a new Coatesville fire-tube boiler and is contemplating the purchase of a new 60-cycle, 1100-volt generating unit. An up-to-date switchboard and watt-hour meters will soon replace the older equipment. The borough of Island Heights is to have in operation during the next month the new series tungsten street-lighting system recently installed. The Toms River division will be similarly equipped. C. A. Brant, general manager.

AMHERST, VA.—The town contemplates voting on a $10,000 bond issue to secure electric light and water supply.

WASHINGTON, D. C.—Sealed proposals will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, until June 22 for furnishing various motor-driven tools for delivery at the Navy Yard, Mare Island, Cal.

WASHINGTON, D. C.—Sealed proposals will be opened at the office of the supervising architect, Washington, D. C., on Aug. 15, for the construction complete, including mechanical equipment, interior lighting fixtures and approaches, of the United States Post Office at Bainbridge, Ga. Drawings and specifications may be obtained from custodian of site at Bainbridge, Ga., or from O. Wenderoth, supervising architect, Washington, D. C.

North Central

ALBION, MICH.—The plant of the Commonwealth Pwr. Co. was recently destroyed by fire caused by lightning. The lighting system will be out of commission until a new plant can be equipped.

COVINGTON, MICH.—The State Railway Commission has given permission to the Sturgeon River Land & Development Co. to issue $8,700,000 worth of bonds, and the company has started work on the construction of a hydroelectric plant. At least 20,000 hp will be developed. The principal storage reservoir will form a lake about 6 miles long and 1½ miles wide, with an average depth of 22 ft. The power house will be located 4 miles from the reservoir. J. K. Gronholf, chief engineer.

DETROIT, MICH.—The Otis Elevator Co. will install an electric elevator in the Garland Theater building on Woodward Avenue.

ESCANABA, MICH.—The City Council has ordered 20 electric lamps installed in the municipal park.

GRAND RAPIDS, MICH.—A. W. Hompe, O. H. L. Wernicke, Charles A. Phelps and Bert MacCauley are interested in a hydroelectric project on the Rouge River. The plan is to erect a concrete dam and to furnish energy to the Grand River Club, the Grand Rapids Auto Co. and farmers in the neighborhood.

HUDSON, MICH.—In about 60 days the Hudson El. Lt. Co. will purchase material to equip a plant in the town of Waldron and will require poles, wire and other line material, as well as a switchboard, transformers, meters and inside wiring material. G. V. Avis, secretary.

ISHPEMING, MICH.—The Buffalo Iron Mining Co. has been awarded the contract for the erection of the buildings and machinery supplies of the Homer mine in the Iron River district. An engine and a boiler house, and also a transformer house, 42 ft. by 36 ft., will be erected. An electrically driven air compressor will also be purchased.

KALAMAZOO, MICH.—The luminous-arc system of ornamental street lighting is favored by the local lighting commission after a thorough investigation of the tungsten cluster system. A recommendation to that effect has been sent to the Common Council.

KALAMAZOO, MICH.—A bond issue of $15,000,000 was recently authorized at a meeting of the stockholders of the Chicago-Michigan Ry. Co. This money will be used for proposed extensions of the company. The stockholders also authorized the building of two large electric power stations on the Manistee River, capable of developing 20,000 hp, to furnish energy for the company's lines.

MASON, MICH.—New machinery is being installed in the municipal lighting plant at Mason.

WATERVLIET, MICH.—The Watervliet Paper Co. is now installing electric motors to operate its machines.

CLEVELAND, OHIO.—City Auditor Thomas Coughlin has offered the city sinking fund commission an additional $500,000 of the municipal light plant bonds. The commission has already purchased $700,000 of these bonds, and if it is able to take the present offering the city will be able to open its new $2,000,000 plant about Nov. 1.

JACKSONVILLE, OHIO.—The City Council is reported to have granted the Hocking Pwr. Co., of Nelsonville, a franchise to furnish electricity in Jacksonville.

RATHBONE, OHIO.—The State Board of Administration has decided to erect a power plant at the Girls' Industrial School. Address W. E. Painter, chief engineer.

YOUNGSTOWN, OHIO.—Michael Liebel, Jr., president of the Youngstown Htg. Co., is seeking a franchise for the installation of an electric-lighting plant. It is the purpose of this company to furnish light, power and steam heat from a lighting plant to be built and operated in connection with the steam-heating plant in South Hazel Street.

CADIZ, KY.—A. P. White & Co., millers, who recently completed a large plant, are planning the installation of an electric-lighting equipment.

EDDYVILLE, KY.—The town recently purchased an electric-light plant from the State, which has operated it in connection with the State penitentiary at Eddyville, and the municipality is now arranging to install a street-lighting system.

ASHLEY, IND.—Within the next 60 days the municipal electric-lighting plant expects to purchase a 60-hp high-speed engine and to erect new arches in its boiler room. Shortly extensions will be made to the 500-watt street-lighting system. George W. Caryl, superintendent.

BRISTOL, IND.—The town is planning an ornamental street-lighting system, the energy for which will be furnished by one of the nearby lighting companies, perhaps the Hawks El. Co., of Goshen. Manager Hilbish of the telephone company is chairman of the lighting committee at Bristol.

CLINTON, IND.—The Clinton El. Lt. & Pwr. Co. within the next month expects to install two 200-hp water-tube boilers. C. M. Poor, superintendent.

KNIGHTSTOWN, IND.—A new air compressor is under test at the city lighting and water plant and will probably be purchased if satisfactory. N. Hiatt, superintendent.

ELGIN, ILL.—Dr. Ralph T. Hinton, superintendent of the Elgin State Hospital for the Insane, has recommended that a new boiler

plant and power house be erected this year. Governor Dunne has signed the bill appropriating $90,500 for this purpose.

KEWANEE, ILL.—The board of directors of the Kewanee Home Tel. Co. has voted to expend $8,000 for switchboard, cable and pole improvements, and $2,000 for instruments.

SPARTA, ILL.—The Sparta Gas & El. Co. has recently installed a new boiler, engine and other equipment. C. R. Gough is manager.

URBANA, ILL.—The city, in connection with the Commercial Club, is figuring on an extensive installation of ornamental posts, about 225 in number, including the park system. The energy for lighting will be furnished by the Urbana Lt., Ht. & Pwr. Co., John A. Glover, general superintendent.

WASHBURN, ILL.—Within the next month the Washburn Ht., Lt. & Pwr. Co. expects to purchase one 35-kva to 40-kva, three-phase, 2200-volt, 60-cycle revolving-field generator with exciter. M. J. Lycan, secretary and treasurer.

WATAGA, ILL.—Within the next three months the Wataga Mill & Lt. Plant expects to erect 2½ miles of line and contemplates the purchase of four cars of poles. The extension will enable the company to serve eleven farmers whose houses will be passed by the new line. H. J. Kunkle, president and general manager.

WESTERN SPRINGS, ILL.—As soon as the new well is finished—it is now down about 800 ft.—a 35-kw, three-phase electric pump will be installed to supply water to the village in place of the steam pump now in use. G. Key, engineer.

BALDWIN, WIS.—The Baldwin El. Lt. & Fuel Co. expects to purchase a switchboard, alternating-current meters, lightning arresters, poles, wires, insulators and other equipment during the next two months and is planning to add also some labor-saving household appliances. S. F. Cave, secretary and manager.

HUDSON, WIS.—The Burkhardt Milling Co. within a few months expects to build an 18-mile transmission line from this place to Baldwin.

VIOLA, WIS.—The Viola Lt. & Pwr. Co. expects to erect a new concrete dam within the next few months and to purchase one 100-hp oil engine. J. N. Roherty, engineer in charge; C. J. Smith, manager.

CHISHOLM, MINN.—Separate bids for the electric work on the proposed public library will be received until July 16. Dr. A. B. Kirk, president library and reading-room board. Belle, Tyrie & Chapman, architects, Auditorium Building, Minneapolis.

CROOKSTON, MINN.—The recent report as to the establishment of a municipal lighting plant here was incorrect.

ELIZABETH, MINN.—It is planned to install an electric-lighting system at this place.

WARREN, MINN.—The municipal lighting plant here will enlarge its plant within the next year or so and contemplates the purchase of one 125-kw or 150-kw, 250-volt direct-current generator direct-connected to engine of suitable size; an open heater, boiler-feed pumps and an additional switchboard panel for the above unit. Electrical appliances and supplies will be purchased as needed from time to time. W. Haney, superintendent.

COUNCIL BLUFFS, IA.—The City Council has decided to extend the lighting district on Eighth Street to Lake View Park, a distance of 1 mile.

ELMA, IA.—The municipal lighting plant at this place contemplates the purchase of a 75-hp Corliss engine within the next two months. Frank Gue, Jr., manager.

FONTANELLE, IA.—An electric-light system will soon be installed at Fontanelle. It is proposed to construct a transmission line and purchase energy from Greenfield, Ia. J. B. Hill, consulting engineer, Iowa City, Ia., has been engaged to prepare plans and specifications for the transmission line and overhead distribution system.

IOWA FALLS, IA.—A complete transmission line, 20 miles long, will be erected within the next three months by the Iowa River Lt. & Pwr. Co., and one 200-kw alternator, a complete switchboard necessitated by changing from direct current to alternating current, transformer equipment and alternating-current meters will be purchased. J. C. Lundy, manager.

LE MARS, IA.—The Le Mars City Wtr. & Lt. Co. expects to purchase within the next three months one 185-kva or 200-kva, 1200-volt, 60-cycle, three-phase generator and a 280-hp engine. Later on the company also contemplates the purchase of a five-panel switchboard. M. Schafer, president and manager.

MANLEY, IA.—At a special election held recently the town voted to grant a franchise to F. J. Hanlon for the erection of a lighting and power plant. It is expected that the plant will be in operation within 90 days and that 24-hour service will be given.

MAXWELL, IA.—C. E. Lookingbill and W. C. Enfield have been negotiating with the Iowa Ry. & Lt. Co. for a transmission line to be run from Nevada to Maxwell. Here a company will be formed to sell energy for lighting and motors. The application of W. A. Curtis for a franchise for an electric-light plant here was mentioned June 7.

SAC CITY, IA.—Seven miles of high-tension transmission line will be erected within the next two months by the Sac City El. Co., which will light the town of Lytton. A switchboard, meters, oil switches, horn-gap arresters and step-up and step-down transformers will be purchased. H. W. Deininger, general manager.

SEYMOUR, IA.—The municipal lighting and water plant expects within the next four months to erect a transmission line 1.5 miles long to the coal mines and plans to purchase two transformers of 50 kw each, an automatic voltage regulator and the necessary poles for this extension, including lightning arresters. Two sets of rocking-grate bars will be purchased later in the year.

STORY CITY, IA.—Improvements are contemplated to the municipal electric plant. A new fireproof building will be erected, and the city will be in the market for a Corliss engine, fire-tube boiler and other equipment. W. H. Grover, Ames, Ia., is the engineer in charge of the improvements. M. Henderson is superintendent of the plant at Story City.

WALL LAKE, IA.—At a special election the proposition to issue electric-light bonds was carried.

KING CITY, MO.—The King City El. & Mfg. Co. expects to purchase at once a 30-kw, three-phase, 60-cycle, 2500-volt alternator with exciter. The company is also in the market for a switchboard.

LAGRANGE, MO.—Within a month or so the municipal electric lighting plant contemplates the purchase of a 25-kw, 60-cycle transformer. C. H. Hoskins, manager.

SEDALIA, MO.—The City Light & Trac. Co. during the next two months expects to purchase a 500-kw turbine with rotary converter and two panels for this unit, and also contemplates making a number of other improvements. Various campaigns for the introduction of labor-saving devices in the home will be inaugurated in the near future. H. D. Frueauff, general manager.

FRANKFORD, N. D.—G. A. Shone is the engineer in charge of the proposed electric-lighting system, for which plans and specifications have been prepared (mentioned April 26 and June 21). Definite plans have not yet been decided upon.

LARIMORE, N. D.—The establishment of a "white way" system, mentioned June 28, has been postponed indefinitely.

CANTON, S. D.—In addition to the equipment that is to be purchased by the Sioux Valley Pwr. Co., mentioned June 21, the 30-ft. poles required for the proposed 13-mile extension to its system will be purchased. The company has a substation at Inwood and one at Fairview. A. H. Latimer and C. H. Morgan are the engineers in charge of the work. The latter is also secretary of the company.

ELK POINT, S. D.—It is reported that Earl Jackson, of St. Paul, Minn., has been authorized by the City Council to draw plans for the installation of an electric-lighting plant here.

McINTOSH, S. D.—It is reported that W. D. Snyder and F. W. Luke have decided to construct an electric-lighting plant.

PAWNEE CITY, NEB.—During the next two months a 12-mile transmission line will be erected by the municipal light and water plant between Pawnee City and Steinauer, Neb. During the next month there will be purchased a triplex pump, with a rating of 160 gal. per minute, and one 500-gal.-per-minute turbine pump for the water-works system. Standards for the street-lighting system will be bought later. T. H. Lawrie, superintendent and manager.

POLK, NEB.—Bonds to the amount of $16,000 have been voted to install an electric-light plant.

ATCHISON, KAN.—The merchants located on East Commercial Street, between Second and Fifth, have petitioned the City Council to extend the "white way" through their section.

Southern States

ALLENDALE, S. C.—A bond issue is being considered for the construction of an electric-light plant and water-works.

ORANGEBURG, S. C.—Bids will be received until July 16 by the Board of Public Works (J. G. Wannamaker, chairman), for $600,000 water and light bonds.

SUMTER, S. C.—The Sumter Ltg. Co. expects within the next eight months to install a new compression ice machine, with a rating of 50 tons. Within the next few months there will be purchased asbestos covering for the settings and drums of its Stirling boilers, shaker grates for the two boilers not already equipped with them, and an auxiliary cooling device for its jet condenser. Very shortly there will be installed fifteen more street series incandescent lamps. Information is wanted in regard to fuel economizers, which will be installed soon. E. H. Moses, general manager.

UNION, S. C.—Within the next two months the municipal electric light and water-works plant will erect one mile of No. 10 lines for the suburban district, for which there has been purchased one 200-kw generator directly connected to a Corliss engine, which is now being installed. R. A. Easterling, manager and superintendent.

APALACHEE, GA.—C. A. Mees, of Charlotte, N. C., is engineer for the proposed hydroelectric plant of the Apalachee Pwr. Co. on the Apalachee River.

REYNOLDS, GA.—It is planned to erect an electric-lighting plant here. The town has a population of 1000. Estimates should be sent to J. A. Matthews, Mayor.

ORLANDO, FLA.—J. B. Magruder has secured a franchise to install a lighting plant and also to build an ice plant.

WEST PALM BEACH, FLA.—A transmission line 18 miles long, to serve the towns of Lakeworth, Lantana, Hypoluxo, Boynton and Delray, lying south of West Palm Beach, will be erected by the Ariston Ice & El. Co. during the next half year. One 300-kw turbo-generator has already been purchased. C. H. Ellis, local manager.

DYERSBURG, TENN.—The municipal water and light plant expects within the next three months to purchase material for 16 ornamental five-lamp standards for a "white way" around the public square. G. A. Shafer, superintendent.

FRANKLIN, TENN.—A substation will be erected by the Harpeth El. Lt. & Pwr. Co. to connect with the lines of the Tennessee Pwr. Co.

NASHVILLE, TENN.—Bids will be received by Major H. Burgess, Corps Engineers, U.S.A., Nashville, until Dec. 11 (extension of date from June 24, mentioned first in issue of March 29) for a franchise for water-power development at Muscle Shoals, Ala. Bids will be for (1) a lump sum contribution by the company toward the entire work of construction of locks, dams, power houses, etc., or (2) it may provide for an annual payment to the United States at so much per horse-power, or a lump sum per year for the lease period, assuming that the United States puts in the above structures, and that the lessee installs hydroelectric equipment and installs necessary transmission lines, substations, etc.; or, (3) the bids may be a combination of these two methods of co-operation. The bids should be based on three different periods of lease, 100 years, 50 years and 20 years. Should any bidder be unable to make a proposition on the shorter term leases, he should so state in writing, giving his reason therefor.

BIRMINGHAM, ALA.—J. M. Dewberry, president of the Tidewater Securities Co., has asked for a franchise by which the right will be given the company to generate and sell electric energy in Birmingham.

VINITA, OKLA.—The Vinita El. Lt., Ice & Pwr. Co., which is now owned and operated by the Public Serv. Co. of Oklahoma, expects to purchase at once one 250-kva alternating-current generator, 60 cycles, 2300 volts, and various switchboard instruments. C. E. Lahman, local manager.

BEEVILLE, TEX.—T. W. Robertson, through A. H. Murrie, has purchased the Beeville Mfg. Co. (lighting and ice plants) for $110,000 from Mrs. Cora Ogden Wilson, of San Antonio.

COMMERCE, TEX.—The City Council is planning to establish a light and water system at at approximate cost of $10,000.

DENISON, TEX.—The Texas Pwr. & Lt. Co. has adopted plans for the proposed hydroelectric plant (first mentioned June 21) that it will erect on Red River, 3 miles north of Denison, at a cost of about $1,000,000. It will construct a system of transmission lines and supply electric energy to a number of towns in this part of Texas and in Oklahoma.

GONZALES, TEX.—Within a short time the Citizens' El. Lt. & Pwr. Co. expects to purchase one 300-hp Corliss engine and a waterwheel governor.

GRAND SALINE, TEX.—It is the plan of the Grand Saline El. Co. to install within the next 60 days 75 bracket street lamps and 12 five-lamp ornamental poles. W. W. White, manager.

HENDERSON, TEX.—To operate the fertilizer plant which the Henderson Cotton Oil & Gin Co. is building, the company contemplates the purchase of one 20-hp motor. O. E. Morris, superintendent.

HOUSTON, TEX.—The Texas Pub. Serv. Co., which has just been organized with its principal office at Houston, having a capital stock of $500,000, will construct electric light and power plants, gas plants and water-works systems in a number of towns in Matagorda, Upshur, Titus and Wilbarger Counties, according to the provisions of its charter. The incorporators are Albert Emanuel, of Dayton, Ohio; H. A. Van Eaton, Raymond Neilson, C. H. Wilson, R. C. Patterson and W. A. Parish, all of Houston.

ITASCA, TEX.—The Texas Lt. & Pwr. Co., which owns the plant at this place, is said to be planning to spend $12,000 in improvements.

SAN ANTONIO, TEX.—The San Antonio Gas & El. Co. has increased its capital stock from $1,160,000 to $1,500,000 for the purpose of providing for improvements to its properties. The San Antonio Tract. Co., an affiliated concern, has increased its capital stock from $1,210,000 to $1,400,000 for the same purpose. Mr. W. B. Tuttle is vice-president and general manager of both companies.

SHERMAN, TEX.—John Tulloch, Liry Building, Sherman, will open bids July 19 for electrical construction at the new hospital and power house.

WHITESBORO, TEX.—The municipal electric-lighting plant will be installed here just as soon as the bonds for $6,000 recently voted have been sold. The issuance of these bonds was mentioned June 28. J. C. Jones, city secretary.

Pacific States

BREMERTON, WASH.—The city of Bremerton recently purchased the holdings of the Bremerton-Charleston Lt. & Fuel Co. It is understood that $90,000 was paid for the property. Reconstruction work will be begun at once.

ELLENSBURG, WASH.—The City Council has been petitioned by property owners in Third Street for the installation of a cluster lighting system.

SEATTLE, WASH.—Bids will be received at the office of the Port Commission, 843 Central Building, Seattle, until July 23 for electric hoisting machine with electric motor, controlling appliances, wire rope and electric wiring and conduit, for what is known as the Salmon Bay improvement of the port of Seattle. Plans and specifications are on file in the office of the commission. C. E. Remsberg is secretary.

FALLS CITY, ORE.—The Falls City El. Lt. & Pwr. Co. will extend its line 1 mile during the next six months, and two transformers, four arc lamps and a new switchboard will be purchased during that period. Henry Brown, superintendent.

KLAMATH FALLS, ORE.—The city contemplates the construction of a municipal lighting and water plant. City Attorney J. C. Rutenic has been instructed to write to Washington to learn under what arrangements the government will furnish energy for the proposed plants. The government owns practically all of the available water-power sites along the Link River, where the power will be generated. If a favorabe response is received from the Department of the Interior, work will begin at once.

PORTLAND, ORE.—The Northwestern El. Co. is planning the erection of a substation on the corner of Albina Avenue and Railroad Street, in Lower Albina, near Portland.

PORTLAND, ORE.—The Southern Pacific Ry. Co. has applied to the California Railroad Commission for permission to issue $30,000,000 in two-year, 5 per cent bonds, to be used in electrifying various lines owned and operated by the company. These extensions will involve an expenditure, it is reported, of almost $17,000,000.

BURNEY FALLS, CAL.—The Pit River Pwr. Co., recently organized by F. J. Sheehan, of San Francisco, will build a plant at Fall River Mills, Shasta County, and supply energy to all the towns and valleys within a radius of 60 miles. It is expected that about 20,000 acres will be irrigated. Mr. Sheehan is seeking the approval of the State Railroad Commission to issue bonds sufficient to complete the financing of the project. It is anticipated that active construction work will begin shortly.

COLFAX, CAL.—The State Railroad Commission has given D. C. Gillen authority to sell his electric distribution system in Colfax to the Pacific Gas & El. Co. for the sum of $12,000. (Mentioned also June 21.)

LOS ANGELES, CAL.—The Southern California Edison Co. is planning to extend immediately its lines to Ingledale Acres, near Los Angeles, and will cover the entire tract with 2200-volt lines and 220-110-volt secondaries.

MAYFIELD, CAL.—City Engineer F. A. Nikirk has advised the purchase and installation of an electric motor at a cost of $400 to provide for an auxiliary pumping plant, as the present supply of water is shrinking rapidly.

PASADENA, CAL.—City Engineer Smith is drawing plans for a motor-driven sewage pump to be installed at the corner of Grand Avenue and Columbia Street, Pasadena. Bids will be received soon for the pumping equipment.

PIEDMONT, CAL.—The board of trustees has secured estimates on the cost of installing a municipal lighting system with underground wires. The report showed that an underground system covering 11.5 miles of street, with arc lamps, will cost $44,000, with $20,000 for poles and wires. Tungsten lighting could be installed for $51,000, with poles and wires costing $22,500. E. C. Prather, city engineer.

PORTOLA, CAL.—A resolution was carried by the board of supervisors last week for a special appropriation of $5,000 to be used in illuminating the city during the festival next October.

SAN DIEGO, CAL.—The San Diego El. Ry. Co. is planning to extend the two large conduits which carry salt water to the condensers at its plant at the foot of Broadway, San Diego. About $100,000 will be expended.

SAN FRANCISCO, CAL.—The State Railroad Commission has rendered a decision granting permission to the Pacific Gas & El. Co. to issue $5,000,000 in bonds. The proceeds of the sale will be used in carrying to completion the work on its Bear River hydroelectric project.

SAN LUIS OBISPO, CAL.—The improvement of the Arroyo Grande plant of the San Luis Obispo Lt. & Pwr. Co. is to be started soon.

SANTA BARBARA, CAL.—The Santa Barbara & Suburban Ry. Co. has been granted a franchise to build and operate an electric line to the Normal School grounds on Mission Ridge, Santa Barbara. Work will be started immediately.

STRATHMORE, CAL.—A 60,000-volt transmission line will be built from the Tule River power plant of the San Joaquin Lt. & Pwr. Co. to this place, and from here to Famosa, where a new substation has just been erected.

SUTTER CREEK, CAL.—Sealed bids will be received up to July 21 for an electric-lighting system for Sutter, in accordance with plans and specifications on file with the clerk, Minnie Provis.

WHITTIER, CAL.—A. R. Rideout, who is building up a 1000-acre estate on the extreme western end of Puente Hills, will install a large lighting plant on his property and arrange for an ornamental street-lighting system.

PARMA, IDAHO.—A cluster lighting system will be installed on the principal streets in the early future. Address city clerk.

PARK CITY, UTAH.—A franchise for an electric-light plant has been asked for by L. A. Jeffs.

Canada

HAMILTON, ONT.—The Hydro-Electric Department of the Hamilton City Council on July 3 adopted the suggestion of Engineer Sifton that the new style flaming-arc lamp recently demonstrated by the Canadian Westinghouse Co., Ltd., be adopted for the central districts, instead of five-lamp tungsten clusters.

HAMILTON, ONT.—City Engineer Macallum has suggested to the Hydro-Electric Board the installation of a steam auxiliary plant on the main line from Dundas, this plant to be of sufficient capacity to take care of the equipment of the city. As an alternative he has also proposed that a steam turbine be installed at the beach plant to generate power solely for the electric pumps.

Miscellaneous

GEORGETOWN, BRITISH GUIANA.—The American vice-consul has transmitted to the Bureau of Foreign and Domestic Commerce, Washington, D. C., specifications covering proposals for two duplicate centrifugal electrically driven pumps to handle surface drainage water, each pump to deliver 7200 gal. per minute, with net head varying from 6 ft. to 14 ft. with the tide. Direct current (510 volts) is to be used. Controlling switchboards and accessories for complete units are to be included.

BELGRADE, SERVIA.—Tenders are invited by the Directorate of the Servian Telephones, Belgrade, Servia, for supplying telephone apparatus and instruments, including 225 common-battery wall telephones, 200 common-battery portable telephones and 200 table telephones. Address Direction des Téléphones Serbe, Belgrade, from which further particulars may be obtained. Local representation is necessary.

New Incorporations

SANTA ROSA, CAL.—The Griffith El. Co., of Berkeley, has been incorporated with a capital stock of $10,000 by D. T. Griffith, Thomas Griffith and A. M. Griffith.

GOLDSBORO, N. C.—The Falling Creek Tel. Co. has been chartered to construct, maintain and operate telephone and telegraph lines. Authorized capital, $10,000. Incorporators: J. B. Kennedy, G. E. Grantham, W. E. Blackman and E. A. Stevens, of Goldsboro, and R. A. Whitfield, Route 2, Princeton, N. C.

RICHMOND, VA.—The Imperial Power Corpn., incorporated with a maximum capital of $15,100,000 and a minimum of $1,000, has been granted a charter. G. W. Phillips, Jr., New York, treasurer. Other incorporators: T. B. Gay, H. H. Chalkley and Ernest Flippen, all of Richmond.

SPOKANE, WASH.—The Marshall Lake Pwr. Co. has been incorporated with a capital stock of $60,000 by W. H. Wright, Madison Street, Spokane, president, and N. E. Lindsay, of the Empire State Building, Spokane. The company has been organized for the development of a power project at Marshall Lake, Wash., near the Idaho line.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JULY 1, 1913.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,065,927. CONTROLLER REGULATOR; C. P. Ebersole, Philadelphia, Pa. App. filed Dec. 30, 1911. To prevent too rapid admission or cutting off of current to the motor.

1,065,940. ELECTRICAL PROTECTIVE DEVICE; J. O. Holton, Springfield, Mo. App. filed July 30, 1912. Fresh fuses automatically placed in circuit.

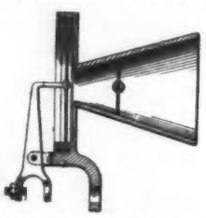
1,065,959. STARTING AND LIGHTING APPARATUS FOR MOTOR VEHICLES; M. Moskowitz, Montclair, N. J. App. filed Dec. 18, 1912. Small-size motor-generator, which is coupled to the engine shaft gradually (friction clutch) as the motor speeds up.

1,065,967. INCANDESCENT-LAMP SOCKET; F. Reutter, Waterbury, Conn. App. filed April 10, 1913. Cap has integral folded projections engaging in slots in the shell body.

1,065,982. VEHICLE PROPELLED BY A COMBINATION OF ELECTRICAL AND MECHANICAL POWER; W. N. Stewart, London, England. App. filed Jan. 19, 1909. Prime mover drives the rotatable field of a dynamo-electric machine, the armature of which is geared to the wheels of the vehicle.

1,065,983. INSULATOR; M. E. Stockwell, Los Angeles, Cal. App. filed May 31, 1910. Longitudinally slotted sheet-metal insulator pin.

1,066,008. TROLLEY CATCHER OR GUARD; A. W. Hart, Glencoe, Ohio. App. filed Aug. 26, 1912. Spring-pressed wire-embracing jaws pivoted on trolley pole in rear of the trolley wheel.



1,066,410—Attachment for Telegraph Instruments.

1,066,016. AUTOMATICALLY DISPLAYED SYNCHRONIZER INDICATOR FOR CLOCKS; E. A. Hummel, St. Paul, Minn. App. filed Aug. 10, 1911. To indicate visually whether the clock was actually synchronized at the proper time.

1,066,051. ELECTRICAL SWITCHING APPARATUS; J. C. Rinker, New York, N. Y. App. filed Nov. 1, 1910. Ball bearings to hold the movable contact in any desired position; dust-proof and moisture-proof switch cover.

1,066,065. METHOD OF PRODUCING SO-CALLED OZONIZED AIR; J. Todd, Sewickley, Pa. App. filed Dec. 14, 1910. Reduces the amount of air passing to the ozonizer as the temperature rises.

1,066,081. RAILWAY SIGNAL RELAY; C. W. Coleman (deceased), Westfield, N. J. App. filed Sept. 2, 1908. Responsive only to periodic currents.

1,066,084. ELECTRIC MEASURING INSTRUMENT; W. W. Crawford, New York, N. Y. App. filed Feb. 8, 1909. Integrating watt-meter free from stray field effects.

1,066,147. ELECTROMECHANICAL TELEGRAPH SYSTEM; W. K. Queen and T. F. Pickett, Needham Heights, Mass. App. filed June 17, 1910. For signaling from pilothouse to engine room; engine-controlled return signal.

1,066,148. PRINTING TELEGRAPH SYSTEM; F. B. Rae, Glen Ridge, N. J. App. filed June 30, 1910. Typewriter-telegraph system.

1,066,159. ELECTRICAL DEVICE FOR TRANSMITTING TO A DISTANCE CONTINUOUS OR INTERMITTENT ANGULAR MOVEMENTS; F. Spalazzi, Naples, Italy. App. filed Sept. 17, 1910. Uses a repeating motor.

1,066,175. DYNAMO-ELECTRIC MACHINE; J. C. Barry, Lynn, Mass. App. filed Oct. 13, 1911. Water-cooled brush support.

1,066,183. CARBON FOR ELECTRIC-ARC LAMPS; H. Caird, Chicago, Ill. App. filed Aug. 29, 1911. Double-coiled wire incased in longitudinal passage in the carbon.

1,066,209. TURBINE GENERATOR; F. Ljungstrom, Liljeholmen, Sweden. App. filed April 10, 1912. Turbine-generator casing supported yieldingly so as not to be affected by unequal expansion.

1,066,215. ELECTRIC BOX; M. Murray, Chicago, Ill. App. filed May 31, 1910. Sectional built-up box with tongue and groove connections.

1,066,216. METER-TESTING CUT-OUT; T. E. Murray, New York, N. Y. App. filed June 12, 1912. Gang plug construction.

1,066,272. CHEMICAL REACTION BY MEANS OF AN ELECTRIC ARC; J. L. R. Hayden, Schenectady, N. Y. App. filed May 8, 1908. Passes gaseous mixture through low-voltage high-current arc, withdraws products in direction of the arc stream and cools resulting compound.

1,066,290. JOINT; C. A. Kraus, Newton Highlands, Mass. App. filed Sept. 8, 1910. Gas-tight seal for electrode lead in vacuum apparatus, etc., composed of tubular members with intermediate vitreous material.

1,066,293. ALTERNATING-CURRENT ELECTROMAGNET; D. L. Lindquist, Yonkers, N. Y. App. filed Feb. 6, 1913. Has primary coil and a secondary conductor carried between the laminations of the core.

1,066,294. ALTERNATING-CURRENT ELECTROMAGNET; D. L. Lindquist, Yonkers, N. Y. App. filed Feb. 6, 1913. Primary coil, fixed secondary conductor disposed within said coil, and a movable laminated core having its polar end recessed to receive the secondary.

1,066,326. ELECTRIC INCANDESCENT LAMP; E. G. Royer, Paris, France. App. filed Feb. 4, 1911. Standard with annular supports and filaments extending vertically between the supports and transversely across the central plane of the standard.

1,066,329. CONDUIT FITTING FOR ELECTRICAL CONDUITS; G. H. Schwendler, Kansas City, Mo. App. filed Aug. 5, 1912. T-fitting provided with an interior curved guiding partition.

1,066,380. ELECTRIC SIGNAL SYSTEM; A. H. Caven, Youngwood, Pa. App. filed Nov. 28, 1911. Trolley pole carries a "sub-trolley" which establishes certain signal circuits.

1,066,385. TROLLEY ATTACHMENT; B. F. Dewees, Logan, W. Va. App. filed Jan. 4, 1911. Pivoted arms are deflected by a cross-wire to raise a pair of guiding fingers in advance of the trolley wheel.

1,066,388. SANITARY TELEPHONE ATTACHMENT; G. W. Downs, New York, N. Y. App. filed Oct. 31, 1912. Flexible sheet looped to hang over the telephone mouthpiece.

1,066,395. INSULATOR; O. J. Fisher, Walpole, Mass. App. filed April 30, 1912. For suspending a conductor from a tree.

1,066,410. ATTACHMENT FOR TELEGRAPH INSTRUMENTS; R. A. Grout, Davenport, Ia. App. filed Sept. 10, 1912. Diaphragm and amplifying horn adapted to be attached to a telegraph sounder.

1,066,429. ELECTRIC HIGH AND LOW ALARM FOR WATER COLUMNS; J. E. Gustin, Fort Dodge, Ia. App. filed Sept. 28, 1911. Separate floats for giving the high and low water alarms.

1,066,432. CONTROL FOR ELECTRIC-LIGHTING SYSTEMS; C. F. Kettering, Dayton, Ohio. App. filed Aug. 10, 1911. For temporarily cutting out the searchlamps and cutting in the side lamps of an automobile, for use when approaching pedestrians, etc.

13,589 (reissue). GROUND-JOINT CONNECTION FOR ELECTRIC CONDUCTORS; J. C. Vogel, Philadelphia, Pa. App. filed April 24, 1912. (Original patent No. 907,543, dated Dec. 22, 1908.) Compressible body member to which the opposite ends of a flexible metallic band are connected so that as body is compressed the band will be tightened about the pipe, etc.